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INSTRUCTION MANUAL

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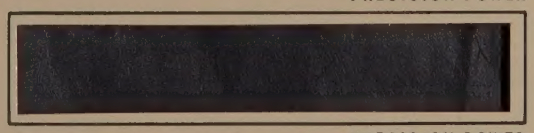

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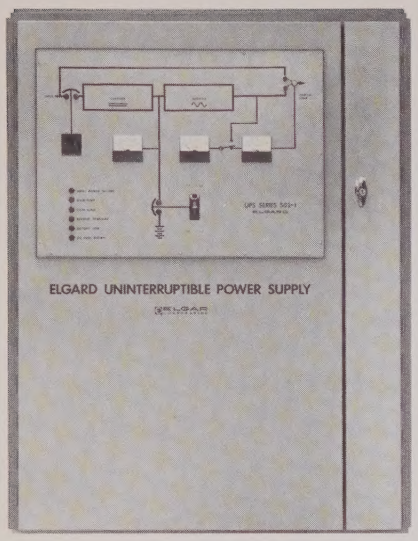

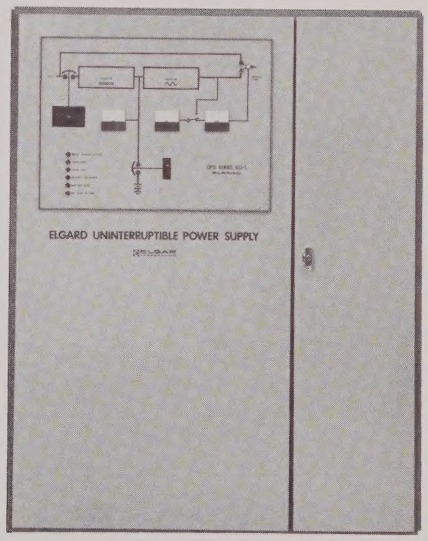

UPS 502-1 & UPS 103-1 UNINTERRUPTIBLE AC POWER SOURCES

627-000-90/10-75/150

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TABLE OF CONTENTS

SECTION I
DESCRIPTION

1-1	Introduction	1-1
1-3	Purpose of Equipment	1-1
1-6	General Description	1-1
1-12	Electrical Description	1-2
1-16	Physical Description	1-2
1-18	Performance Specifications	1-2

SECTION II
INSTALLATION

2-1	Introduction	2-1
2-3	Receiving Inspection	2-1
2-5	Installation Requirements	2-1
2-9	Installation Instructions	2-4
2-12	Battery Installation	2-4

SECTION III
OPERATION

3-1	Introduction	3-1
3-3	Controls and Indicators	3-1
3-5	Functional Checkout	3-2

SECTION IV
THEORY OF OPERATION

4-1	Introduction	4-1
4-4	General Description	4-1
4-29	Charger Logic Board	4-3

SECTION V
MAINTENANCE

5-1	Introduction	5-1
5-3	Test Equipment Required	5-1
5-5	Preventive Maintenance	5-1

TABLE OF CONTENTS (Continued)

5-7	Corrective Maintenance	5-2
5-9	Checkout	5-2
5-19	Troubleshooting	5-3
5-27	Repair and Replacement	5-4
5-29	Circuit Board Assemblies	5-4
5-31	Factory Repair	5-4

SECTION VI
DIAGRAMS

6-1	General	6-1
6-3	Diagrams and Parts Layout	6-1

SECTION VII
PARTS LIST

7-1	General	7-1
7-3	Spare Parts Ordering	7-1

SECTION VIII
OPTIONAL STATIC BYPASS SWITCH

8-1	Introduction	8-1
8-3	General Description	8-1
8-6	Field Installation	8-1
8-8	Theory of Operation	8-1
8-18	Turn On and Forward Transfer	8-2
8-21	Manual Reverse Transfer	8-3
8-23	Automatic Reverse Transfer	8-3
8-25	Maintenance	8-3
8-27	Parts List	8-3
8-29	Diagrams	8-3

LIST OF ILLUSTRATIONS

2-1	UPS 502-1 Physical Dimensions	2-2
2-2	UPS 103-1 Physical Dimensions	2-3
3-1	UPS 502-1 Front Panel Controls	3-3
3-2	UPS 103-1 Front Panel Controls	3-4
4-1	UPS 502-1, Rear of Front Door	4-8
4-2	UPS 103-1, Rear of Front Door	4-9
5-1	UPS 502-1, Inside View	5-7
5-2	UPS 103-1, Inside View	5-8
6-1	Overall Single Phase UPS Schematic	6-2/6-3
6-2	Parts Layout, Charger Logic Board	6-4/6-5
6-3	Charger Logic Board Schematic	6-6/6-7
6-4	Parts Layout Charger Gate Drive	6-8/6-9
6-5	Charger Gate Drive Schematic	6-10/6-11
6-6	Parts Layout, Inverter Logic Board	6-12/6-13
6-7	Single Phase Inverter Logic Board Schematic	6-14/6-15
6-8	Parts Layout Inverter Gate Drive	6-16/6-17
6-9	Single Phase Inverter Gate Drive Schematic	6-18/6-19
8-1	Optional SBS Power Pack Assembly	8-8
8-2	Optional SBS Power Pack Schematic	8-9
8-3	Optional SBS Logic Board Assembly	8-10
8-4	Optional SBS Logic Board Schematic	8-11

LIST OF TABLES

1-1	UPS 502-1 Performance Specifications	1-3
1-2	UPS 103-1 Performance Specifications	1-4
5-1	Test Equipment Required	5-3
5-2	Troubleshooting Chart	5-5
8-1	Troubleshooting Chart	8-4

SECTION I
DESCRIPTION

1-1. INTRODUCTION

1-2. This instruction manual has been prepared for use with the Elgar single-phase, 5 KVA (UPS 502-1) and 10 KVA (UPS 103-1) Uninterruptible AC Power Sources. The instructions it contains are intended for use by operators and technicians with regard to installation, operation, adjustment, troubleshooting, and repair of both single-phase UPS units.

1-3. PURPOSE OF EQUIPMENT

1-4. Both UPS units have been specifically designed for use as emergency sources of AC power. In the event of any main power line dropout, brownout, or blackout, the Uninterruptible AC Power Source will continue to provide dependable single-phase AC power at either 120 VAC or 240 VAC and at power rating associated with the unit's model number.

1-5. The Elgar UPS units can be used in a variety of applications providing uninterrupted operation of such equipment as; computer systems, data acquisition systems, critical electronic hospital equipment, etc. Therefore, installation of either the UPS 502-1 or UPS 103-1 will eliminate any unscheduled down time of critical electronic equipment that may be caused by power line abnormalities.

1-6. GENERAL DESCRIPTION

1-7. Both Elgar UPS units consist of three main sections; a Bypass Switch, a Battery Charger, and an Inverter with either an Elgar supplied external battery or a customer supplied battery. In any event the rating of the battery should meet your specific operating requirements.

1-8. In either case, the battery should be capable of accepting a float charge voltage of 190 VDC. The nominal voltage required from the battery to adequately provide power to the inverter is 168VDC. When the battery is discharged to 145VDC the Inverter will automatically shut down. The full load current (0.8 pf) at discharge is 40 amperes maximum for the 5KVA UPS and 80 amperes for the 10KVA UPS.

1-9. The Battery Charger has been designed to keep a constant float charge on the battery pack; thus,maintaining constant maximum battery capacity in the event of any power line failure, the batteries are ensured of maximum charge and ready to provide emergency AC power. As well as keeping a float charge on the battery pack, the Battery Charger provides power to the Inverter.

1-10. Once the UPS unit is installed and connected to the external critical load and the AC line power, the Inverter draws its power from the battery charger. When a power failure occurs the Inverter continues to provide AC power to the external load by automatically drawing its energy from the battery pack. Because the battery pack is constantly in the Inverter input power loop, there is no switchover time usually associated with a transition from AC line voltage to battery power.

1-11. When the AC line failure is corrected, the battery charger automatically resumes powering

the Inverter and again places a float charge on the battery pack.

1-12. ELECTRICAL DESCRIPTION

1-13. The input power required by the UPS units is 240 VAC ±10%, 57 Hz to 63 Hz, single-phase AC power. The output voltage generated by the UPS is either 120 VAC ±2% or 240 VAC ±2%. The output frequency is normally synchronized to the input, however, it may be operated non-synchronized if the UPS is powered by a widely varying input frequency power source; such as that obtained from motor generators. When under battery pack power, the inverter maintains an output frequency of 60 Hz, ±0.25%.

1-14. The Inverter output voltage can be monitored on the Output Voltage Meter located on the front panel of the UPS. The load current can be monitored on a front panel mounted AC Output Ammeter. Also located on the front panel are two circuit breakers which allow for turn-on and safeguarding the Battery Charger and Inverter circuitry. Front panel indicators provide visual indication of mode of operation, warnings and other operations of the UPS unit. All front panel mounted controls and indicators are explained in Section III.

1-15. Also, contained in the UPS is an output sensing feedback circuit which maintains a regulated 120/240 VAC at the output even under varying load conditions. The UPS also features a current sensing network that reduces the output voltage of the UPS in the event of overvoltage condition with the UPS. The front panel mounted circuit breakers and the Inverter fuse provide additional safeguarding in the event of the UPS unit's AC and DC lines becoming shorted. In the event a UPS failure does occur, the unit will initate a reverse transfer and the front panel Reverse Transfer light will light giving a visual indication of the malfunction. Reverse Transfer is a feature that causes the Inverter output to be bypassed and the input AC line voltage to be connected directly to the external critical load. An internal line fuse safeguards the Reverse Transfer power line, eliminating the possibility of current damaging the AC power line.

1-16. PHYSICAL DESCRIPTION

1-17. Both the UPS 502-1 and UPS 103-1 are housed in an all steel cabinet. Front doors allow access to all electronic circuitry and both units can be mounted against a wall without obstructing access to their electronic circuitry. Also featured is an enclosed cabinet which houses the Battery Pack. The physical dimensions of the UPS 502-1 and UPS 103-1 are presented in Figures 2-1 and 2-2 respectively.

1-18. PERFORMANCE SPECIFICATIONS

1-19. The performance specifications for both the UPS 502-1 and UPS 103-1 appear in Tables 1-1 and 1-2 respectively.

TABLE 1-1. UPS 502-1 PERFORMANCE SPECIFICATIONS

INPUT	
Voltage	240V ±10% single phase.
Frequency	57-63 Hz
Rectifier/Charger Current Limiting	100% of full load rating; full load rating includes battery charging and load requirements.
Current In-rush Limiting	25% to 100% of full rated load over 1.5 seconds.
Power Factor	0.7 lag or greater at full load.
OUTPUT	
Rating	5.0 KVA at 0.8 power factor lagging.
Voltage	120/240V single phase 3 wire, ±5% manually adjustable.
Voltage Regulation*	±1%
Frequency*	60 Hz ±0.25%, adjustable ±5%.
Harmonic Content	Maximum 5% RMS.
Voltage Transient for:	Percent Rated Voltage 0 to Peak
33% load step	±8%
Loss of AC input power	±4%
Return of AC input power	±2%
Voltage Transient Recovery Time	Recovery to 95% of steady state within 50 milliseconds.
Frequency Transients	Maintained within limits of ±0.2%
Overload	125% for 10 minutes. 150% for 10 seconds. 200% for 10 cycles.

*For the following conditons:
a. 0 to 100% load.
b. 1.0 to 0.8 load power factor.
c. Minimum to maximum battery voltage.
d. 10^{o} to 40^{o}C operating temperature.

TABLE 1-2. UPS 103-1 PERFORMANCE SPECIFICATIONS

INPUT	
Voltage	240V ±10% single phase
Frequency	57-63 Hz
Rectifier/Charger Current Limiting	100% of full load rating; full load rating includes battery charging and load requirements.
Current In-rush Limiting	25% to 100% of full rated load over 1.5 seconds.
Power Factor	0.7 lag or greater at full load.
OUTPUT	
Rating	10.0 KVA at 0.8 power factor lagging.
Voltage	120/240V single phase 3 wire, ±5% manually adjustable.
Voltage Regulation*	±1%
Frequency*	60 Hz ±0.25%, adjustable ±5%.
Harmonic Content	Maximum 5% RMS.
Voltage Transient for:	Percent Rated Voltage 0 to Peak
33% load step	±8%
Loss of AC input power	±4%
Return of AC input power	±2%
Voltage Transient Recovery Time	Recovery to 95% of steady state within 50 milliseconds.
Frequency Transients	Maintained within limits of ±0.2%.
Overload	125% for 10 minutes. 150% for 10 seconds. 200% for 10 cycles.

*For the following conditions:
a. 0 to 100% load.
b. 1.0 to 0.8 load power factor.
c. Minimum to maximum battery voltage.
d. 10^{o} to 40^{o}C operating temperature.

SECTION II
INSTALLATION

2-1. INTRODUCTION

2-2. The Elgar UPS units are calibrated and quality tested prior to shipment. The unit is therefore ready for installation and operation upon receipt. This section provides instructions to aid in performing a receiving inspection, as well as information to aid in installation.

2-3. RECEIVING INSPECTION

2-4. Because of the physical size of the Elgar UPS units, they will not be typically shipped within a container. Therefore, it is important to make a visual inspection of the instrument to ensure it has arrived free of any shipping damage. The following list is provided to aid you in making this inspection.

1. Visually inspect the unit's exterior for any signs of damage such as dents, scratches, or disorders.
2. Check the front panel controls for ease of operation.
3. Ensure the front panel indicators as well as the front panel meters, are not damaged.
4. Visually inspect the interior of the UPS unit for broken components. Also ensure the plug-in circuit boards are securely positioned in their proper receptacles.

NOTE

If obvious damage is evident, both the shipping agency and Elgar Corporation should be notified immediately. To notify Elgar Corporation in the event of damage, send a Damage Report to the Elgar Service Department, 8225 Mercury Court, San Diego, California, 92111. Elgar in return will provide instructions for repair or replacement of the unit. Under no circumstances should the unit be returned without the approval of Elgar Corporation.

2-5. INSTALLATION REQUIREMENTS

2-6. The UPS units have been designed for floor mounting. The physical dimensions of the UPS 502-1 and UPS 103-1 appear in Figures 2-1 and 2-2 respectively.

2-7 Power Requirements

2-8. Both UPS units operate from 240 VAC ± 10%, 57 Hz to 63 Hz, single phase input power. Both units also have a barrier terminal strip for connecting the input power. The UPS 502-1 requires 55 amps and the UPS 103-1 requires 110 amps of input current. Optional input voltages are available on a special order basis. The input terminal strip is located in the upper left hand corner of the UPS unit as you face the UPS with the door open. It is located in the same location for both the UPS 502-1 and UPS 103-1 and is also labeled TB1 in both instances.

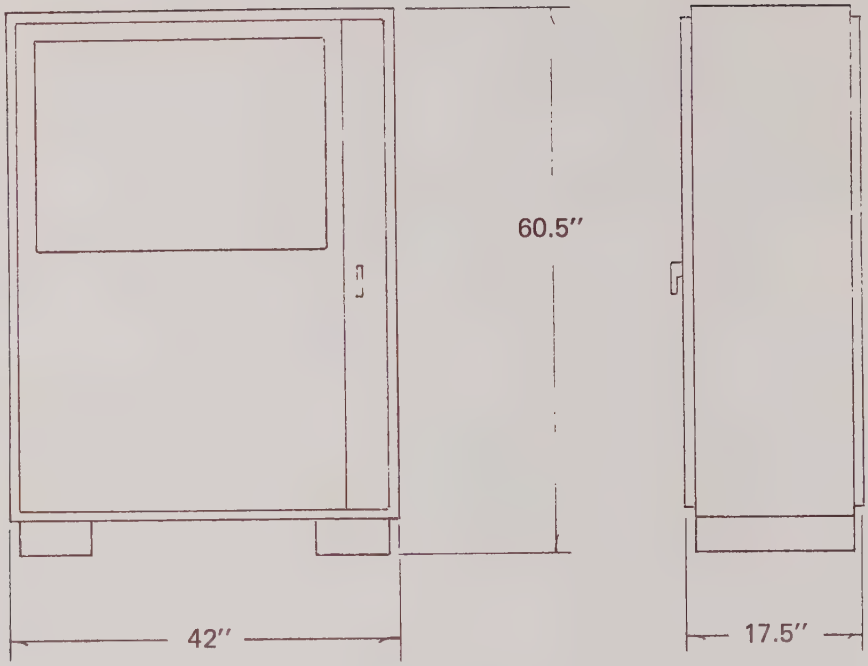


Figure 2-1. UPS 502-1 Physical Dimensions

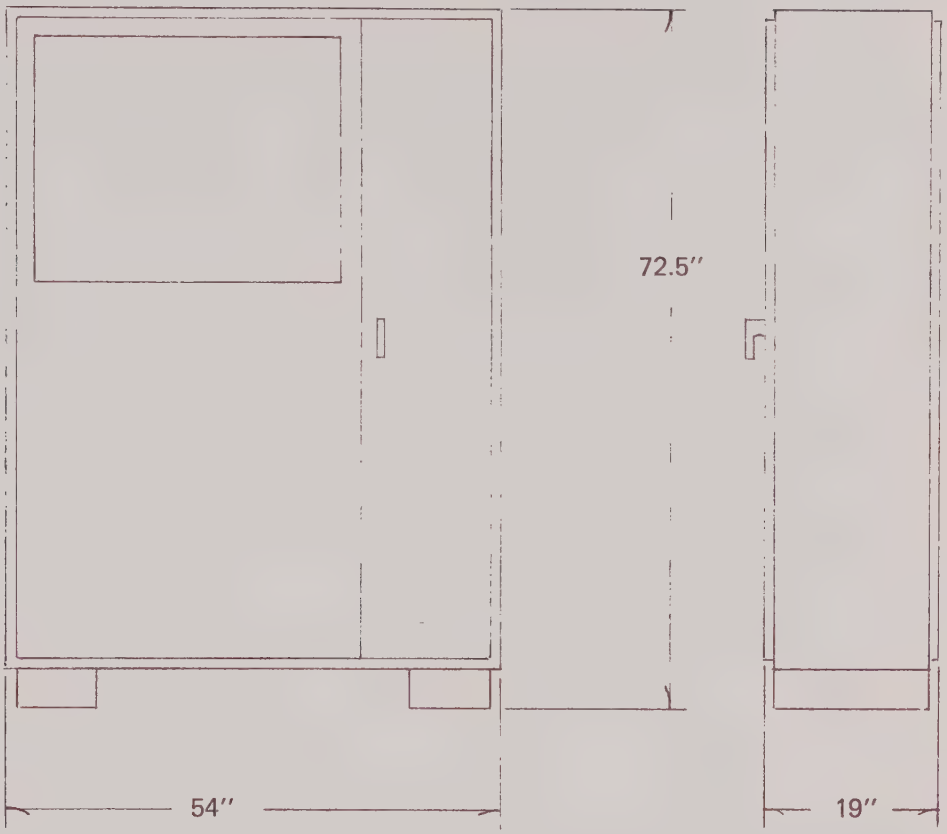


Figure 2-2. UPS 103-1 Physical Dimensions

WARNING

When the UPS unit is installed, AC line voltage is present in the unit. Extreme caution should be used and contact to exposed terminals should be avoided or shock or loss of life could result.

2-9. INSTALLATION INSTRUCTIONS

2-10. The following list is provided to aid in installing either the UPS 502-1 or UPS 103-1.

1. Place all front panel mounted switches to the OFF position and ensure the Disconnect Switch located on Battery Pack is in the OFF position.

2. Connect the input line power to the input power terminal strip using No. 6 gauge wire for the UPS 502-1 and No. 4 gauge wire for the UPS 103-1. The input power connections are as follows: High to TB1 pin 1, low to TB1 pin 2 and ground to TB1 pin 3.

NOTE

Do not connect the UPS unit to an AC power line that will not provide a minimum of 216 VAC when the UPS is fully loaded or the unit will not adequately float charge the batteries to their full capacity. If your line voltage will not meet the above requirements contact the Elgar Service Department concerning your particular application.

3. Connect the external load to the output terminal barrier strip, located in the upper right corner of the unit as you face the UPS with the door open. This terminal strip is labeled TB2 for both the UPS 502-1 and UPS 103-1. A dummy load should be used during initial installation and replaced with the actual load once the unit is verified as operational. Pin connections are as follows: High to TB2 pin 1, low to TB2, pin 2 and neutral to TB2 pin 3.

4. The UPS units are shipped from the factory with pins 5 connected to 1, and 6 connected to 2 on TB1. This enables the input line power to be automatically connected to the external load when the UPS is in the By-Pass mode of operation. These jumpers must be removed if operation without by-pass, or if separate by-pass power other than the main AC line is desired. If power other than the main AC line is to be used for the By-Pass mode of operation, remove the above mentioned wires and wire the separate source as follows: High to TB1 pin 6, low to TB1 pin 5 and neutral to TB1 pin 4. TB1 pin 3 and 4 are wired together and should remain connected. If separate by-pass power is used it should be ensured that the phasing on the output does not reverse when transfering from UPS power to By-Pass power. If the phasing does reverse, the By-Pass High and Low lines must be interchanged.

2-11. After the input power has been connected to the UPS unit and the external load has been connected, it is then possible to install the Battery Pack.

2-12. BATTERY INSTALLATION

2-13. Optional Elgar Battery Pack.

2-14. The optional Elgar maintenance free battery pack is shiped with all internal battery connections made, however, the following list is provided to aid you in ensuring these connections have not been damaged in shipment and to also help in connecting the battery pack to the UPS.

1. Ensure all jumpers on the batteries are secure.

2. Place the Disconnect Switch located on the front panel of the battery pack OFF.

3. Attach the battery pack to the side of the UPS using the large holes and bolting them together. The side cover of the UPS becomes the side cover of the battery pack.

4. The two wires coming from the Disconnect Switch should be attached to the two buss bars that run across the top inside of the UPS. The red wire must be connected to the buss bar marked with a "+".

5. Connect a DC voltmeter across the buss bars. Close the battery disconnect switch and ensure the voltmeter reads approximately 168 VDC. If a reading either substantially higher or lower is indicated a problem exists and the disconnect switch should be turned off immediately, and contact the Elgar Service Department. If the voltage is correct, move the red lead of the voltmeter to the center connection of CB2, located on the front door. If the voltage present is the same as that measured across the buss bars, installation of the battery pack is completed and reference to Section III for instructions concerning preliminary check out should be accomplished prior to turn-on.

2-15. Separately Supplied Battery.

2-16. In the event a battery other than the optional Elgar maintenance-free battery pack is used, the positive and negative leads should be connected to the two buss bars that run across the inside top of the UPS. The positive must connect to the buss bar marked "+". A removable metal plate, located on top of the UPS cabinet, facilitates access to the buss bars.

NOTE

Consult the information provided with the separately supplied battery for its installation and connection information.

SECTION III
OPERATION

3-1. INTRODUCTION

3-2. This section contains information regarding the preliminary functional check-out for both UPS units, as well as a list of instructions regarding their operation. Also included is a description of the controls to aid in understanding the operation of the UPS units.

3-3. CONTROLS AND INDICATORS

3-4. The controls and indicators associated with the UPS 502-1 and UPS 103-1 are shown in Figures 3-1 and 3-2 respectively. Their functions are as follows:

1. AC POWER CIRCUIT BREAKER, CB1
   Applies AC line power to the battery charger and inverter. Also energizes the internal power supply.

2. BATTERY CIRCUIT BREAKER, CB2
   Applies the Battery Pack power to the DC buss bars located inside the UPS unit.

3. CRITICAL LOAD LAMP
   This amber lamp will light when power is applied to the external critical load.

4. ILLUMINATED GREEN PUSHBUTTON
   When pushed the button will light indicating the UPS is providing power to the external critical load.

5. ILLUMINATED RED PUSHBUTTON
   When pushed, the button will light red indicating the external load has been transferred from UPS power to by-pass power.

6. AC POWER ON LAMP
   This green lamp will light whenever the AC Power Circuit Breaker is on and AC input line voltage is present.

7. AC POWER OFF LAMP
   This red lamp will light when the AC input line power is not present and the inverter is operating.

8. OVERLOAD LAMP
   This red lamp will light when the UPS is overloaded.

9. BATTERY LOW LAMP
   This lamp will light red before the battery pack is discharged to a level that will cause the inverter to shutdown.

10. OVER TEMPERATURE LAMP
    Will light red when the temperature inside the UPS cabinet becomes excessive.

11. REVERSE TRANSFER LAMP
    Will light red when the external critical load is being supplied with by-pass power.

12. DC FUSE LAMP
    Will light red if the special semiconductor fuse inside the UPS is electrically blown.

13. INPUT POWER FAILURE LAMP
Lights red when the AC Power Circuit Breaker is OFF or if AC input line power is not available.

14. BATTERY VOLTAGE VOLTMETER
Monitors the DC Buss voltage.

15. OUTPUT VOLTAGE VOLTMETER
Monitors the AC voltage present at the output terminals of the UPS.

16. OUTPUT CURRENT AMMETER
Monitors the output current from the UPS.

17. CB2 ON LAMP
This lamp will light green when the Battery Circuit Breaker is in the ON position.

18. CB2 OFF LAMP
This lamp will light red when the Battery Circuit Breaker is in the OFF position.

3-5. FUNCTIONAL CHECKOUT

3-6. The following lists have been provided to aid in performing a preliminary functional checkout of the UPS unit. While performing the checkout of the UPS it is recommended that a dummy load be used until the unit is verified as operational. The following list of instructions is provided.

1. Set the AC Power Circuit Breaker to the ON position. Observe that the AC Power On Lamp lights and remains on. Do not continue operation if the circuit breaker trips at any time. After a time delay of approximately 2 seconds the DC voltage reading on the front panel mounted Battery Voltage Meter should read +190 volts.

2. Set the Battery Circuit Breaker to the ON position and ensure the green lamp lights and remains on. (The Battery Circuit Breaker has an "undervoltage" release and cannot be turned on until the DC voltage is at a high enough level.) Also ensure all alarm indicators are OFF with the exception of the Reverse Transfer Lamp. The Output Voltage Meter is now reading the AC input line voltage with the small selector switch in the DOWN position. Lifting the selector switch will allow the meter to read the output voltage of the UPS.

3. Push the Illuminated Green Pushbutton to connect the external load to the UPS. At this point the amber lamp should be ON and the Reverse Transfer Lamp should go to OFF. The UPS is now operating in "Forward Transfer" and the UPS output voltage will appear at the Output Voltage Meter even with the selector switch in the DOWN position.

4. To additionally check the UPS units operation, place the AC Input Circuit Breaker OFF and observe that the output load voltage and current readings on the front panel meters does not change. Power is now being supplied by the Batteries and the Input Power Failure Lamp should be lit. The DC voltage measured on the Battery Voltage Meter should gradually decrease.

5. Turn the AC Power Circuit Breaker ON and ensure the Input Power Failure Lamp goes out. After a delay of 2 seconds the DC voltage present on the meter should slowly increase to its preset value of +190 volts.

NOTE

Do not repeat steps 4 and 5 after initial checkout. Constant recycling of the batteries reduces their life expectancy.

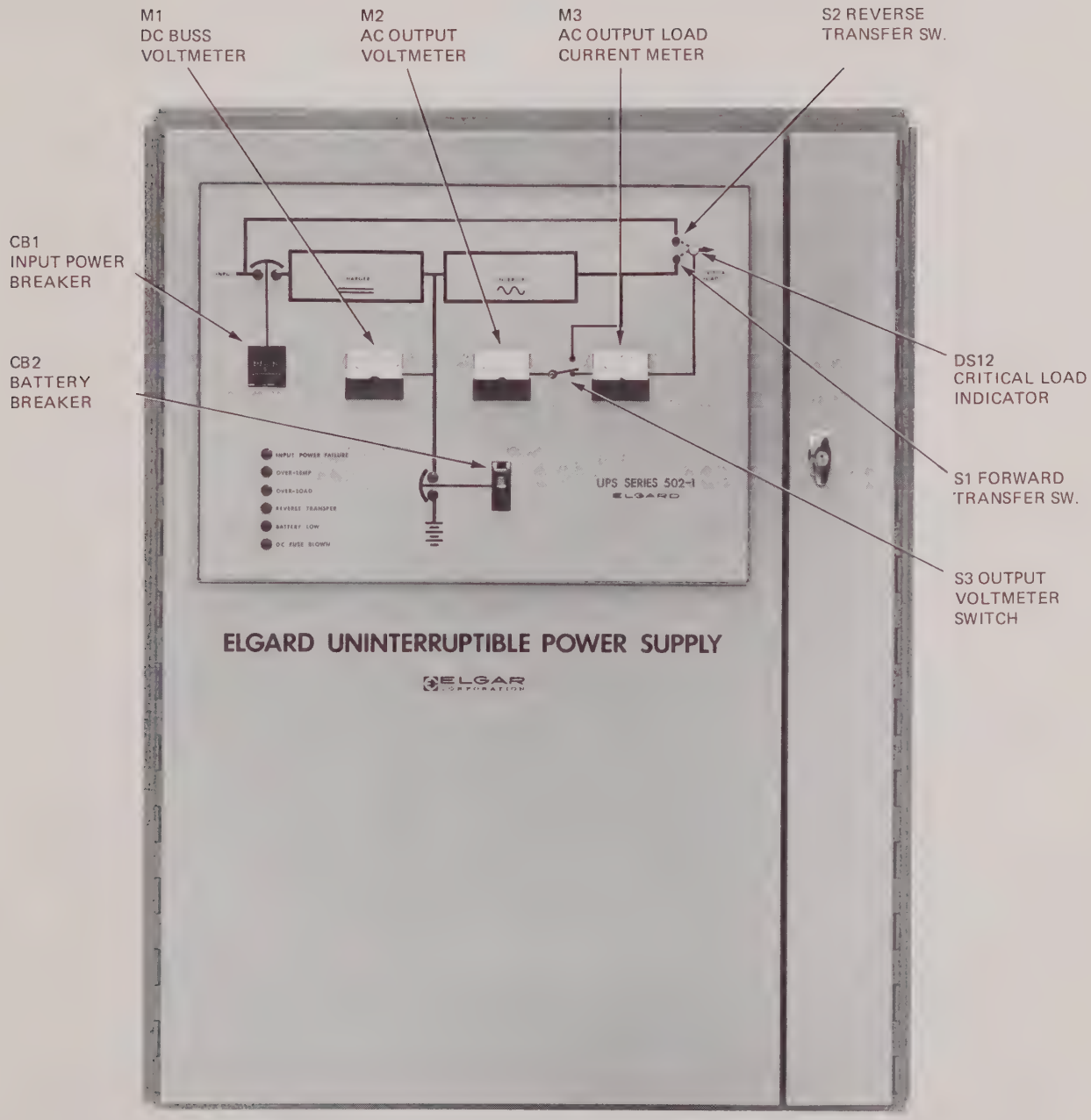
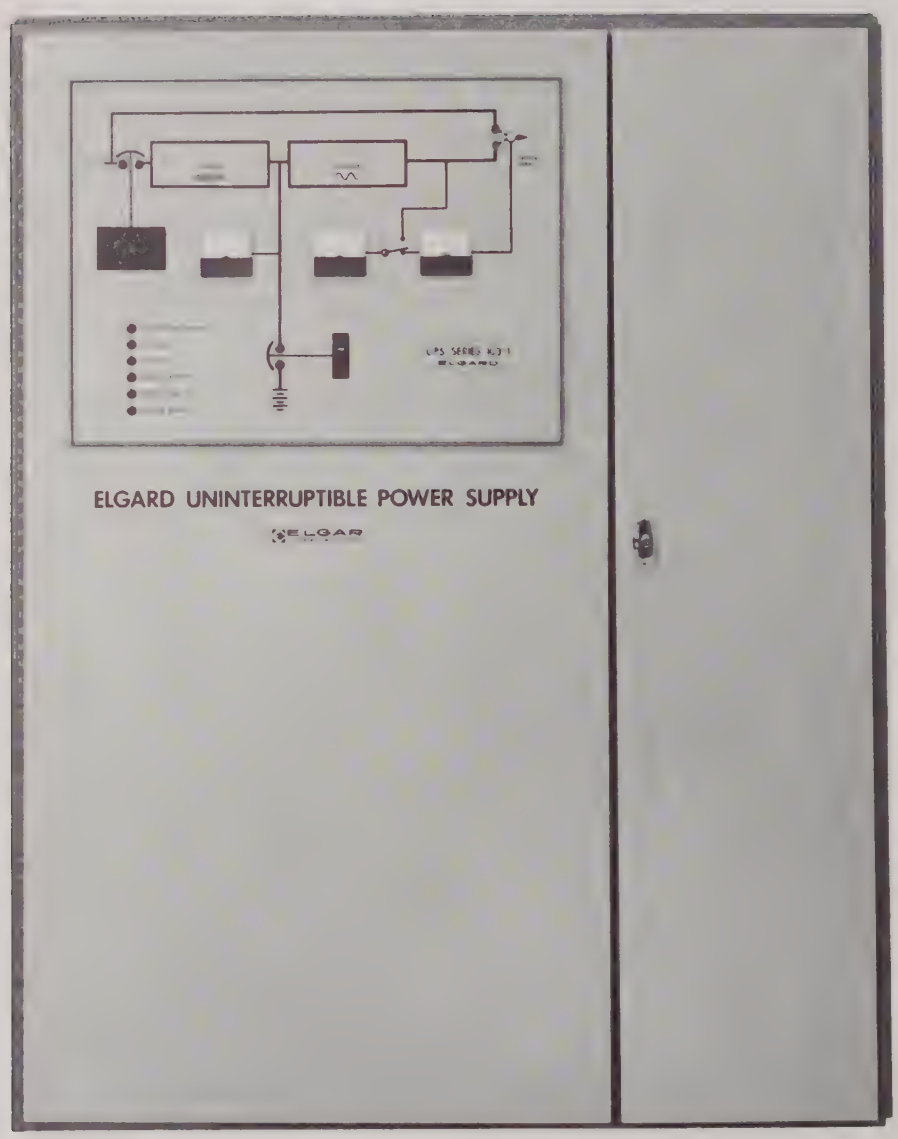


Figure 3-1. UPS 502-1 Front Panel Controls



(SAME AS 502-1)

Figure 3-2. UPS 103-1 Front Panel Controls

SECTION IV
THEORY OF OPERATION

4-1. INTRODUCTION

4-2. This section contains an overall description of both UPS units as well as the description of each major circuit in the UPS.

4-3. Also contained in this section is a description of the Input AC Power Circuits and the Logic Board Power Circuits. The theory of operation for the Charger Logic Board and the Inverter Logic Board is also discussed.

4-4. GENERAL DESCRIPTION (Reference Figure 6-1)

4-5. The UPS units consist basically of a Battery Charger, Battery Pack, and an Inverter. When the AC Power Circuit Breaker (CB1) is closed, the 240 VAC input line power lights the AC Power On Lamp (DS1) and energizes the Battery Charger Circuits through bridge rectifier BR1. At the same time, relay K1 will also energize which turns OFF the AC Power Failure Lamp.

4-6 Input AC Power.

4-7. The input line power is conducted through the RFI chokes (L1 and L2) and applies to the full wave controlled rectifier consisting of two diode rectifiers (CR5 and CR6) and two SCR's (SCR5 and SCR6). After rectification, the DC power is supplied to the DC buss through the LC filter formed by choke L3 and capacitor C1. In addition to forming a part of the bridge rectifier, diode rectifiers CR5 and CR6 act as free wheeling diodes for the stored energy in choke L3 when SCR's SCR5 and SCR6 turn off.

4-8. The output power of the phase-controlled rectifier bridge is controlled by the charger logic circuit board which supplies the trigger power through the charger gate drive board to SCR's SCR6 and SCR5.

4-9. Logic Board Power.

4-10. DC power for operation of the logic boards is furnished by a 30 volt DC control buss which is parallel fed by transformer T2 and bridge rectifier BR1 (from the incoming line) and transformer T3 and bridge rectifier BR2 (from the inverter output). Either or both of these sources are used so that DC power is alway available while the system is operating.

4-11. The main DC buss negative and the control DC buss negative are at the same potential which is control common.

4-12. Charger Logic Board.

4-13. The charger logic board regulates the DC buss voltage by varying the firing angle of SCR5 and SCR6 in a manner designed to hold the DC buss voltage constant. Main DC buss voltage is sensed by the charger logic on pins 6 (common) and 1 (+). Positive control buss (+30 DCV) is applied to pin 22 and output trigger power is furnished at pins 18 and 19 to the gate power circuit for SCR's SCR5 and SCR6.

4-14. The secondary of line transformer T1 is tied to pin 6 (common) and pin 21 to furnish timing information to the charger logic board. Current limit information is supplied by current transformer CT1 sensing at pins 2 and 3. In case of low main DC buss voltage, a turn off signal is provided to the inverter logic board from pin 5.

4-14. A normally closed contact on relay K1 is wired from pin 20 of the charger logic board to common. When relay K1 operates, this contact opens and allows a timing circuit to slowly bring up the main DC buss voltage over a period of several seconds, thus allowing capacitor C1 to charge without excessive DC current demand.

4-16. Once DC output voltage is available on the main DC buss, the under-voltage release coil on circuit breaker CB2 will release, thus allowing CB2 to be closed, placing the DC battery across the main DC buss.

4-17. The charger will now hold the DC buss voltage at the correct value to "float" the battery as well as furnish the required DC to power the inverter. The charger will re-charge the battery after use for input AC line voltages as low as 216VAC. Below this voltage, and as low as 190VAC. the battery is no longer charging, although the inverter will continue to operate on the line without using the capability of the battery. The DC buss voltage is monitored by the front panel DC voltmeter.

4-19. Alarm circuits monitor the battery (main DC buss) voltage on the charger board and relay K1 monitors the input AC line. When input line failure occurs, the inverter continues to operate without interruption taking power from the battery. K1 operates off, however, and indicates this condition on the front panel "AC Power Failure" lamp, DS5. In addition, a contact closure is furnished on terminals 3 and 4 of TB7 for use with remote alarm.

4-19. When less than 5% of battery operate time remains, the charger logic board detects this condition and energizes DS3, the "Battery Low" pilot light on the front panel, and, in addition, gives a contact closure at terminals 1 and 2 of TB7 for remote alarm purposes.

4-20. Inverter Logic Board.

4-21. DC power is furnished to the inverter section through fuse F1. The inverter consisting of SCR1, 2, 3, 4, L4, L5, C8, 9, 10, 11, is a Mac Murray-Bedford bridge type inverter, which furnishes AC power to primary terminals 1 and 4 of output summing transformer T4. The bridge rectifier consisting of CR1-4 is used to return reactive power to the DC buss during appropriate portions of the cycle.

4-22. The secondary of T4 feeds the output autotransformer T7 through the series filter L6-C6 and the shunt filter capacitor C7. Transformer T5 and rectifier bridge BR3 effectively limit the short circuit current available by clamping the voltage across capacitor C6 to the main DC buss voltage.

4-23. Output shunt circuits L8-C5 and L9-C4 are used to reduce harmonics in the output voltage, while rectifier bridge BR4 and capacitor C2 are used to clip short unwanted transients from the output.

4-24. Current transformer CT2 is used to detect output current overload, which, through action of the inverter logic board, reduces the output current to a safe value and energizes the DS11 "AC overload" pilot light.

4-25. Output Circuit-Transfer Operation.

4-26. The bypass supply is fed into the unit through fuses F2 and F3 to bypass contactor K2 and out to the external critical load. K2 closes when AC input power is connected. Contactors K2 and K3 control the forward and reverse transfer operation of the UPS, through the switching of S1 and S2.

4-27. When the input breaker is closed, and the DC buss voltage is high enough, CB2 can be closed. This will close an auxillary contact which provides operating voltage to relay K4. K4 is the control relay that determines the condition of K2 and K3. Pushing the momentary switch/lamp S1 (Green) located on the front panel will cause K4 to close. This will open K2, the bypass contactor, and close K3, the UPS contactor, thus switching the external critical load from bypass to UPS output. Pushing switch/lamp S2 (Red) will open the control relay K4, causing the load to be transfered back to bypass. Any time the DC circuit breaker is opened the output will transfer to bypass.

4-28. A switch, S4, is located on panel A-1. This switch must be in the "SBS Out" position, when no

SBS logic board is installed in J1, or the above switching will not take place. The SBS is a static bypass switch which is installed as an option for customers requiring extremely fast forward and reverse transfer times.

4-29. CHARGER LOGIC BOARD (Reference Figure 6-3)

4-30. The functions of the Charger Logic Board are as follows:

1. Provides control of the main DC buss voltage to the correct value of "float DC voltage" required by the Battery Pack. This is accomplished using drive and synchronization circuits as well as voltage regulation circuitry.

2. Limits the magnitude of the current that the UPS unit can draw from the incomming line.

3. Provides low DC protection by providing a signal to turn the inverter off in the event the main DC buss voltage drops below the pre-set under voltage valve. Also provides local and remote signal indicating the Battery Pack is near shut down.

4-31. General.

4-32. Unregulated +30DCV is brought to the charger logic board on pin 22 (high) and pin 6 (common). Q101, R101, R102 and C102 from a series regulator, referenced to CR101, which furnishes regulated +15 DCV control power for use on the charger logic board.

4-33. Drive and Synchronization.

4-34. A small sample of the incoming AC power is brought into the charger logic board through pin 21, carried through R103 and R104 to the base emitter circuit of Q102. Diode CR102 is used to clamp the base voltage of Q102 and to protect the emitter from reverse potential. Q102 will therefore conduct on each positive half-cycle of the input AC applied to pin 21. The collector voltage of Q102 is applied to the paralleled input terminals of Z101. Z101 is a quad dual input gate package with each successive gate changing state such that pin 9 and pin 12 alternate high and low on each half cycle of the input AC on charger logic board pin 21. When pin 21 is high with respect to common, pin 9 of Z101 is low and pin 12 of Z101 is high.

4-35. Z103 is driven by the output of Z101. Since Z103 is an R-S flip-flop, pins 9 and 6 are alternately high and low, thus turning on Q103 and Q104 on alternate half-cycles as Z101 sets and re-sets Z103.

4-36. Pins 18 and 19 (as well as +30DCV) are fed into the charger gate drive board to the gate drive transformers and then to the gates of SCR5 and SCR6.

4-37. Voltage Regulation.

4-38. The main DC buss voltage is brought into the charger logic board on pin 1, and sampled by R123, R124, and R125. The float voltage adjust is R124. This DC voltage is referenced against zener CR113 in operational amplifier Z106, the output of which is compared to a pulse input (described later) in operational amplifier Z105. The output of operational amplifier Z105 is commoned to pins 8 and 11 of the gate chain and therefore to the clock input to Z103, the R-S flip-flop.

4-39. The pulse input to Z105 is derived from the collector circuit of Q105 which, in turn is driven by the negative going pulses from terminal 6 or terminal 3 of Z101. Thus, on every zero crossing of the AC input on terminal 21, Q105 conducts and applies voltage to terminal 3 of Z105. The output of Z105 on terminal 6 is therefore a rectangular pulse, high at the beginning of the pulse and dropping to low early in the half-cycle if the main DC buss voltage is low and late in the half-cycle if the main DC buss voltage is high.

4-40. This pulse is applied to the clock input on Z103, and serves to reset the flip-flop in that state until the input synchronizing signal again crosses zero and another negative going pulse turns on Q105.

4-41. The change of state of Z103 is used to drive Z102 and the charger gate drive transistors Q103 and

Q104. There transistors, in turn, drive the gate of the power SCR's through the charger gate drive transformers located on the charger gate driver board. Thus the main DC buss voltage is regulated by adjusting the delay angle for firing the SCR's.

4-42. Current Limiting.

4-43. A current transformer in the incoming AC line feeds terminals 2 and 3 of the charger logic board. This signal is rectified by diodes CR114, 115, 116 and 117, and compared to Zener CR113 by amplifier Z107. Current limit adjustment is provided by R127. The output of the current limit amplifier, Z107, is applied to the same input of Z105, the comparison amplifier, as is the output of Z106, the voltage detection amplifier.

4-43A. Thus, if the input AC current to the UPS exceeds the limit set by R127, the outout of Z107 will go low, thus driving the charger supply to reduce it's output to whatever level is required to reduce the line current to the preset value.

4-44. The current limit, therefore, takes control of the supply during any period of time that line current attempts to exceed the set value.

4-45. Low DC Voltage Protection.

4-46. Two undervoltage detection levels are provided one by Z108 and a somewhat higher value by Z109. Both of these values are adjusted simultaneously, maintaining their pre-set ratio, by R132.

4-47. The higher of these two undervoltage values, detected by Z109, is used to turn on transistor Q107, thus both lighting the low battery pilot light on the front panel of the UPS, and energizing relay K1 on the charger logic board to close the remote low battery contacts.

4-48. If the battery voltage continues to drop, Z108 will detect the lower value, it's output will go high, and being connected to latch Z104 on pins 12 and 13, will latch pin 3 of Z104 low and present this low signal to pin 5 of the charger logic card.

4-49. This low signal is connected to the inverter logic card on pin F and acts to stop inverter action. All of the above is true providing the line to pins 9 and 10 of Z104 is low. If pins 9 and 10 are high, however, the final gate (pins 1, 2, 3) will not go low when pin 1 goes high, but will not remain low. This function is incorporated to prevent a false under voltage inverter shut down on turn on. Additional low DC voltage protection is provided by Z110. If a power failure should last longer than the battery back-up time an inverter shut-down will occur. When the AC power comes back ON, the inverter will automatically start again. Should the power again fail, before the inverter phases completely out, the +30 VDC supply will be lost while the inverter is still running, resulting in a blown DC fuse. Z110 monitors the +30VDC supply through a voltage divider and references it to a zener regulator. As the +30VDC increases, the output of Z110 holds the under voltage line low, disabling the inverter from starting, until the +30VDC supply reaches a minimum of +24 VDC. This will ensure that the DC supply is high enough to operate the internal logic and continue to operate if the AC voltage fails again.

4-50. Turn On Sequence.

4-51. Before application of incoming AC power to the UPS, pin 20 of the charger logic board is connected to common by relay K1 (see overall schematic). This action holds pins 4, 5, 9 and 10 of Z102 low and prevents any firing of the SCR's. When K1 operates, the short between pin 20 of the charger logic board and common is opened, and pins 4, 5, 9, 10 rise as capacitor C103 charges.

4-52. The opening of relay K1 (main schematic) also removes the connection between CR110 and common. This action turns on Q106, which pulls pin 2 of Z105 negative and greatly delays the firing angle of the power SCR's. As capacitor C107 charges towards the +15V supply, Q106 gradually turns off and the firing angle advances, giving a "walk-in" to the regulated DC buss voltage.

4-53. Limit Stops.

4-54. R105 is used to provide a small amount of hysteresis in the action of Z101, and assures that, even under high DC buss voltage conditions such that a comparison is missed in the voltage comparator, Z105, a state change occurs in the R-S

flip-flop, Z103, at the end of the half-cycle.

4-55. Similarly, CR106 is used to pull pin 2 of voltage comparison amplifier Z105 more negative at the beginning of the half-cycle, thus assuring a minimum width pulse at pin 6 of Z105 at the beginning of the half cycle, even under very low DC buss voltage conditions wherein a voltage comparison is missed in Z105. Thus these two circuit elements function as limit stops, CR106 on the maximum output edge of the pulse and R105 on the minimum edge of the pulse.

4-56. INVERTER LOGIC BOARD (Reference Figure 6-5)

4-57. The functions of the Inverter Logic Board are as follows:

1. Determines the Inverter frequency, using a clock oscillator.
2. Controls the Inverter output voltage using voltage regulating circuitry.
3. Controls Inverter turn-on and turn-off sequence using special control and sequencing circuitry.

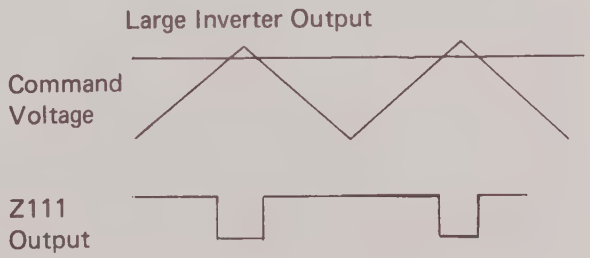
4-58. Clock Oscillator.

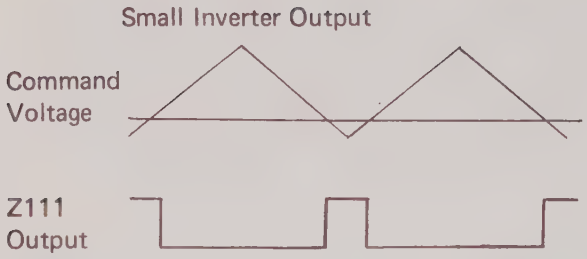
4-59. The clock oscillator provides 60 Hz and 120 Hz square wave outputs derived from a 60 Hz closed loop feedback oscillator. The oscillator loop consists of integrator Z105, active filter Z107 and comparator Z108. The loop connection affords negative DC feedback to stabilize the operating point of the oscillator. Integrator Z105 provides 90^{o} phase shift and active filter Z107 provides an additional 90^{o} phase shift to give net positive feedback at 60 Hz. The square-wave output of comparator Z108 is applied to integrator Z105 through a constant-current element consisting of bridge rectifier CR102, CR103, CR105 and CR106 and constant-current diode CR104. The constant-current element forces the oscillator to assume an operating point which gives a symmetrical output square-wave. The output of Z105 is a triangular waveform in quadrature phase to the square-wave from Z108. This wave is further filtered in active filter Z107 to give a nearly sinusoidal output to comparator Z108. A 12 V RMS line sync signal from pin 20 is clipped to approximately 1.2V pk-to-pk by CR116 and CR118 and applied to comparator Z108 to synchronize the oscillator. When line voltage is present, the oscillator operates synchronous to and in phase with the line sync signal.

4-60. Comparator Z106 senses the zero crossings of the triangle from Z105 to produce a square-wave at its output shifted 90^{o} in phase from the square-wave from Z108. A constant current element consisting of bridge rectifier CR107, CR108, CR110, CR111 and constant current diode CR109 provides negative DC feedback around Z106 which ensures that the square-wave at Z106 output is symmetrical.

4-61. The two quadrature square-waves from Z106 and Z108 are combined in Z110, connected as an exclusive –OR gate, to produce a symmetrical 120 Hz squarewave for the voltage control circuitry.

4-62. Comparator Z111 controls the output voltage of the inverter by providing appropriately timed clock pulses to the lead and lag flip-flops, Z102 and Z104. The 120 Hz square-wave from Z110 is integrated by R115 and C107 to produce a 120 Hz triangular wave. This triangle is applied to pin 2 of Z111 and compared to the command voltage at pin 3. When the triangle waveform falls below the command voltage, Z111 output goes positive, triggering the lead flip-flop. When the triangle rises above the comparison voltage, Z111 output goes to ground, triggering the lag flip-flop. The lead and lag inverter outputs are summed such that when the lead and lag flip-flops are in different states the inverter is delivering power and when they are in similar states, the inverter output is zero. Thus, the time during which the inverter delivers power is when the triangle voltage falls below the voltage command level.





4.63. In some transient or overload situations, the command voltage may rise completely above the triangle waveform or fall completely below it, causing Z111 to cease providing clock pulses to maintain the inverter at maximum or minimum output until the command voltage returns to its normal range. When the command voltage is too high, Z111 output remains high, but the clock line at Z112 pin 6 is pulled down momentarily at the positive peak of the triangle wave by the action of differentiating circuit C108, R116 which pulses Z112 pin 10 when the negative transition of the 120 Hz square-wave occurs.

4-64. When the command voltage is too low, Z111 output remains at ground, but the clock line at Z112 pin 6 is driven positive at the negative peak of the triangle by differentiating circuit C109, R117 which pulses pin 5 of Z112 at the negative transition of the inverted 120 Hz square-wave from Z112 pin 11.

4-65. The lead flip-flop receives trigger steering information from the quadrature 60 Hz square-wave from the clock oscillator to ensure that the inverter has the proper phase relationship relative to the line sync signal. The lag flip-flop trigger steering information is taken from the lead flip-flop. Pulse delay circuit Z113 delays the clock signal to the lead flip-flop so that, at minimum output the lag flip-flop changes state before the lead flip-flop.

4-66. The output voltage command signal at Z111 pin 3 comes from a diode gate consisting of R125, CR117, CR119, CR120 and CR121. This gate causes the output voltage command to correspond to the least positive of four control signals; the output voltage control signal from Z114, the output current control signal from Z115, the soft-start signal from C114 or the under-voltage signal from the charger logic board.

4-67. Voltage Regulator And Overcurrent Circuitry.

4-68. The inverter output voltage is sensed by T6. The secondary voltage from T6 is rectified by bridge rectifier CR112-CR115 and a portion of this voltage applied to voltage regulator op-amp Z114. This voltage sample is compared to +6 V DC from reference zener CR128. Any error voltage is amplified by Z114 and applied to CR117 to control the output voltage.

4-69. The inverter output current is sensed by current transformer CT2. The voltage from CT2 is rectified by bridge rectifier CR124-CR127. A portion of this rectified voltage is applied to current regulator op-amp Z115 where it is compared to +3.1V DC derived from the +6.2V DC reference voltage. The output of Z115 is normally near +15V DC, however, if the output current exceeds the inverter rating, the output of Z115 becomes less positive and through CR119, reduces the inverter output so as to limit the current to the rated value. At the same time, the reduced output voltage of Z115 causes transistors Q106 and Q107 to turn on, lighting the AC overload lamp on the front panel.

4-70. Control And Sequencing Circuits.

4-71. Inverter gate drive signals from lead and lag flip-flops Z102 and Z104 are coupled to the inverter gate transformer T1 and T2 through buffer gates Z101 and Z103 and gate driver transistors Q102-Q105. Besides the flip-flop inputs the buffer gates have additional inputs from time delay capacitor C117 and gate power flip-flop Z116, which control the application of gate power to the inverters.

4-72. Power On Sequence.

4-73. Time delay capacitor C117 prevents the application of any gate drive signals to the inverter before the logic power supply has come up to +15 volts. It also ensures that the gate power flip-flop, Z116, comes up initially in the off state. While gate power is off, the pin 3 output of Z117 keeps

the soft-start capacitor C114 discharged.

4-74. When the under-voltage signal from the charger logic board goes high indicating that the DC buss voltage is high enough to run the inverter, time delay capacitor C116 begins to charge. When C116 has charged to approximately 6.5V DC, it permits a clock pulse from Z109 pin 8 to set the gate power flip-flop, Z116, causing Z116 pin 8 to go high. This permits buffer gates Z101 and Z103 to apply gate drive signals to the inverters. The inverter output is held at minimum by soft start capacitor C114 which now begins to charge, raising the inverter output until voltage regulator Z114 takes control of the output voltage.

4-75. Power Off Sequence.

4-76. When the undervoltage signal goes low, indicating insufficient DC buss voltage to maintain rated inverter output, the inverter output is immediately reduced to minimum by CR121. Time delay capacitor C116 is discharged thru Z117 blocking the gate power turn on pulses and time delay capacitor C115 begins to charge. When C115 has charged to approximately 6.5V DC, it permits clock pulses from Z109 pin 8 to reset the gate power flip-flop, turning off the inverter gate drives by bringing Z116 pin 8 low.

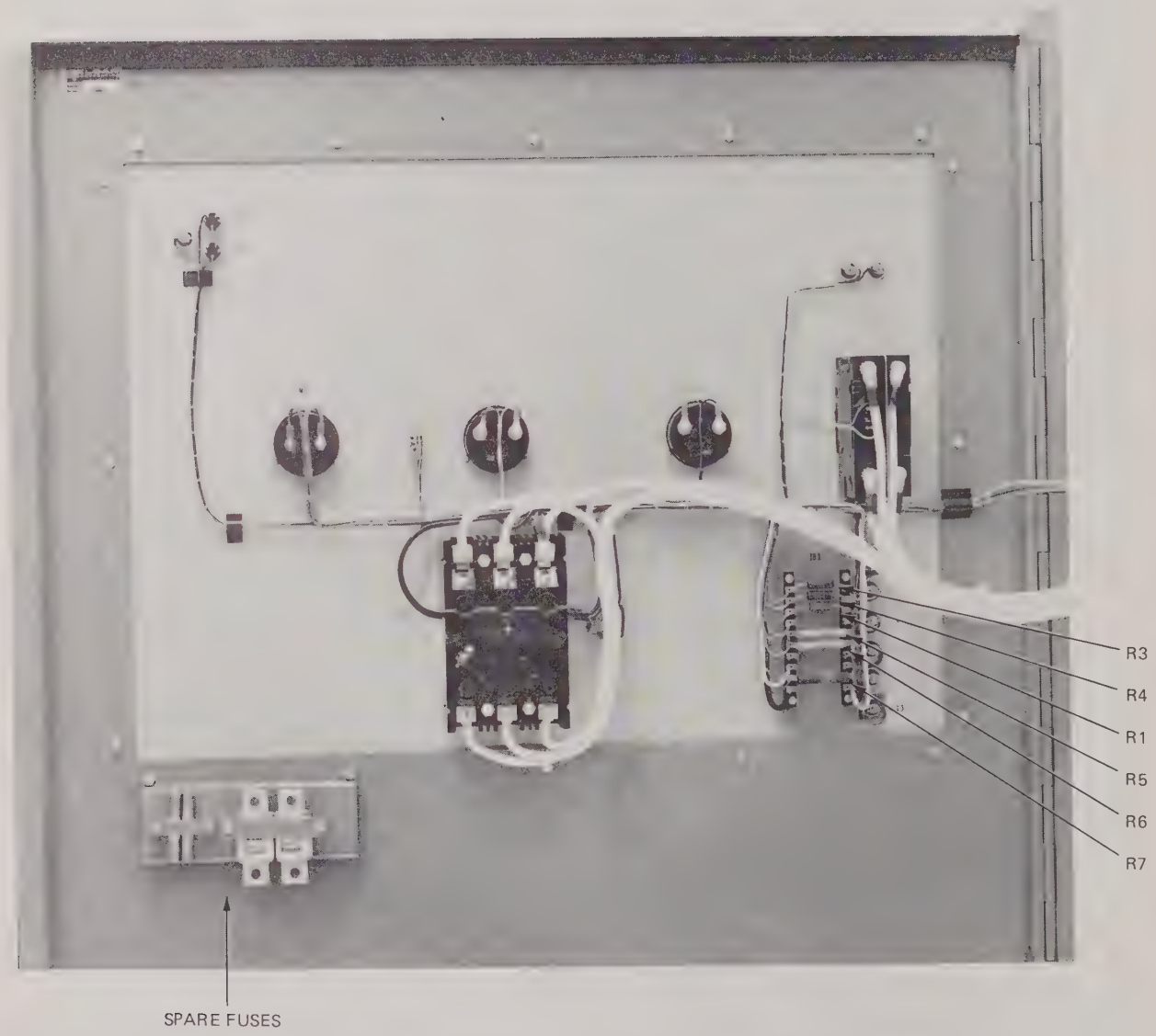


Figure 4-1. UPS 502-1, Rear of Front Door

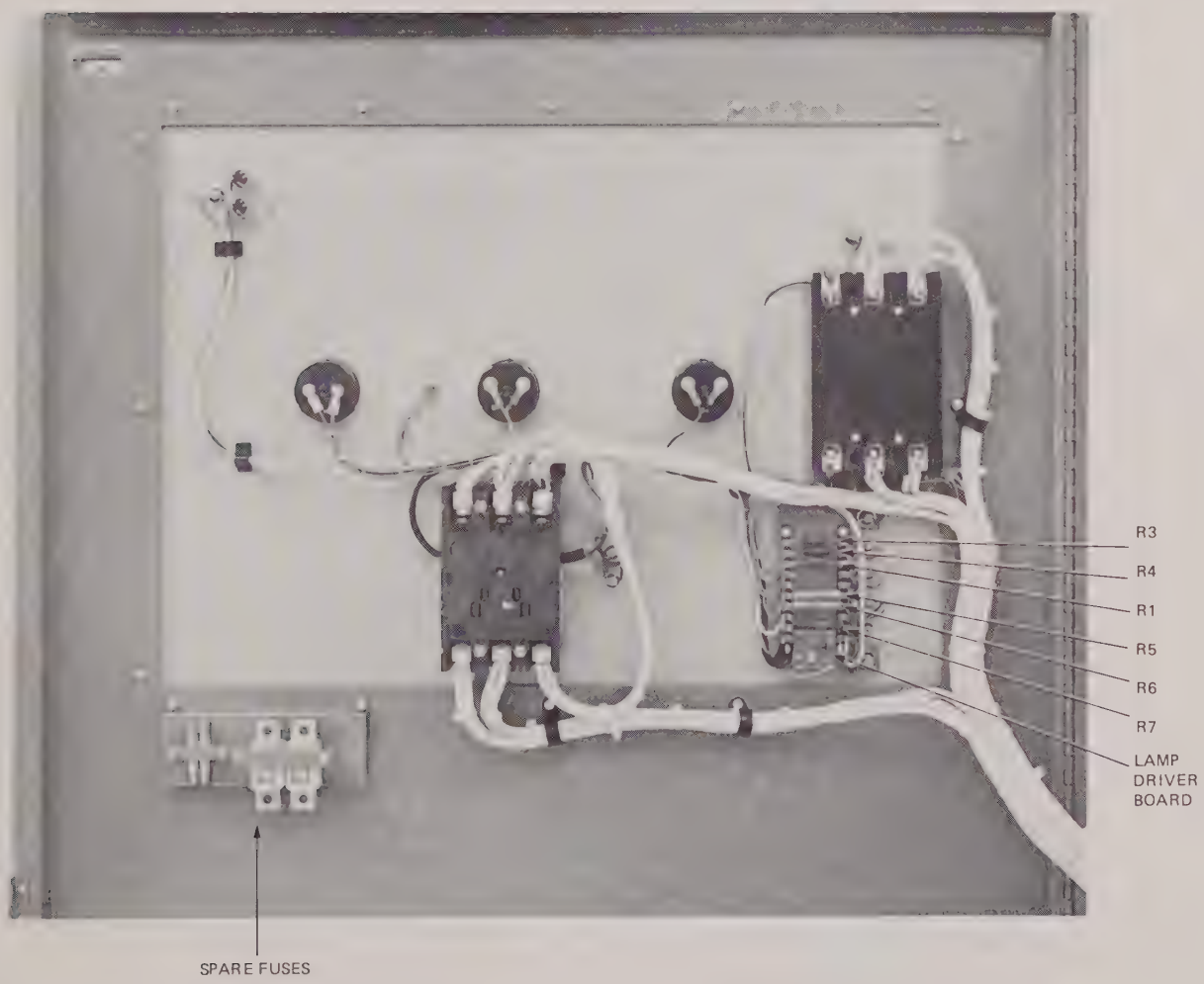


Figure 4-2. UPS 103-1, Rear of Front Door

SECTION V
MAINTENANCE

5-1. INTRODUCTION

5-2. This section contains procedures for preventive and corrective maintenance. Preventive maintenance consists of procedures for cleaning and inspecting the unit. Corrective maintenance includes checkout, troubleshooting, disassembly for repair, and adjustments. A list of special tools and test equipment required for maintenance and adjustment is also included in this section.

NOTE

Elgar Corporation is not responsible for instruments returned for repair without proper Elgar authorization. Please contact Elgar Corporation or its authorized representative to make return shipment of instrument. The unit should be returned to Elgar Service Department, 8225 Mercury Court, San Diego, California 92111.

5-3. TEST EQUIPMENT REQUIRED

5-4. The test equipment required for maintenance and adjustment are listed in Table 5-1. Equivalent test equipment may be used.

WARNING

Disconnect AC input power whenever performing maintenance on the unit. Failure to comply can result in serious electrical shock to persons coming in contact with live voltages present at exposed terminals when unit is connected. Even with the AC power off, the battery has full voltage on its terminals.

5-5. PREVENTIVE MAINTENANCE

5-6. Preventive maintenance is comprised of cleaning and inspection of the unit. The UPS unit should be cleaned and inspected at regular periodic intervals (every six months, depending on operating conditions). To clean and inspect the unit, proceed as follows:

1. Inspect circuit board parts for evidence of overheating, such as burned or distorted resistors, capacitors, and charred insulation. Replace parts suspected of damage.

2. Inspect circuit board parts for evidence of physical damage, such as broken or cracked capacitors and resistors, broken solder joints and discontinuities in circuit foil paths.

3. Inspect circuit board connectors for corrosion and obvious physical damage. Remove corrosion with clean, lint-free cloth dampened in trychlorethylene; replace circuit board assembly if damaged.

4. Inspect chassis and front panel-mounted components for broken connections,

burned insulation or damaged parts.

5. Inspect transformers for evidence of overheating such as discolored insulation.

6. Inspect rear panel connector and terminal blocks for damage such as broken wire leads, cracked insulation.

5-7. CORRECTIVE MAINTENANCE

5-8. Corrective maintenance consists of checkout, troubleshooting, adjustments, and repair. Troubleshooting procedures are presented in paragraph 5-14 to aid in isolating suspected malfunctions in the unit.

5-9. CHECKOUT

5-10. The unit should be checked after initial installation and at periodic intervals to ensure that it is operating at optimum performance. The following checks and adjustments are included for your convenience.

5-11. Output Voltage Check and Adjustment.

5-12. To check and adjust the output voltage, proceed as follows:

1. With AC Power and Battery Circuit Breakers ON, observe front panel Output Voltage Reading, with critical load on UPS output.

NOTE

Meter accuracy is ±3%. If more accurate reading is desired, connect external voltmeter to output terminals.

2. If output voltage requires adjustment, adjust R119 on inverter logic board for desired output voltage (230-240 volts rms). The output is set to 240 VAC at the factory.

5-13. Frequency Check and Adjustment.

5-14. To check out and adjust the output power frequency of the unit for synchronized and non-synchronized operation, proceed as follows:

1. Switch unit off.

2. Connect oscilloscope to Output Voltage connection of the unit. Set Oscilloscope trigger for Line Sync.

3. Apply AC input power. Set the Battery switch Circuit Breaker to ON for a check of synchronized output frequency. Place UPS unit in Forward Transfer.

4. Observe that waveform on oscilloscope is stable (no movement), indicating that the inverter clock oscillator output is at 60 Hz.

5. To check the internal oscillator, leave battery breaker on. Switch AC input circuit breaker off. The unit is now running on battery. Observe that waveform on oscilloscope is stable (no movement), indicating that the inverter clock oscillator is at 60 Hz. If it is not, rotate frequency adjust potentiometer R111 of inverter board as needed to stabilize waveform at 60 Hz ±0.25%.

5-15. Float Voltage Check and Adjustment.

5-16. To check out and adjust the battery float charge voltage, proceed as follows:

1. Set AC Power switch circuit breakers to ON.

2. Observe that the Battery Voltage meter reads 190 volts. The float voltage adjustment can be performed only if the charger voltage regulator is in control. If adjustment is required, rotate potentiometer R124 of charger circuit board.

5-17. Battery Capacity Check.

5-18. The battery capacity checkout should be performed at six-month intervals. Frequency battery capacity checks are not recommended as they may reduct the battery performance. To check out the battery capacity, proceed as follows:

1. Connect the rated load 4 KW (5 KVA at 0.8 power factor) 8 KW (10K VA at 0.8 power factor) across the Output Voltage connections.

2. Start the unit as in paragraph 3-5.

3. Set the AC Power Switch-Circuit Breaker to OFF. Record the time that it takes for the battery to discharge to a level that initiates shutdown.

4. Recharge batteries for a period of 24 hours, thus ensuring they are fully charged.

5-19. TROUBLESHOOTING

5-20. Troubleshooting should be accomplished only after checkout procedures indicate a malfunction. The troubleshooting procedures are presented in Table 5-2. General troubleshooting techniques are as described in the following paragraphs, in the form of adjustments.

5-21. Transistor Check.

5-27. Check transistors for failure while installed on circuit boards as follows:

1. Verify power is removed from circuit.

2. Set multimeter to measure resistance with RX1 OHMS scale. (Note that current supplied by various multimeters and ohmmeters varies and use ohm scale appropriate for testing transistors in the following steps.)

   a. With negative voltage lead on emitter, positive voltage lead on base, verify

WARNING

Isolate all test equipment from ground using isolator plug or serious damage to UPS will occur.

TABLE 5-1. TEST EQUIPMENT REQUIRED

Name	Manufacturer and Model Number	Characteristics
Multimeter	Simpson Electric Co. Model 260	20,000 ohms/volt, AC/DC/OHMS ranges
Differential Voltmeter	John Fluke Mfg. Co. Model 931	RMS Volts Range to 1000 VAC
Oscilloscope	Tektronix, Inc. Model 561	
Differential Preamplifier Module (plug-in)	Tektronix, Inc. Model 2A63	
Probe "A"	Tektronix, Inc.	X10 Probe, DC coupling
Probe "B"	Tektronix, Inc.	X10 Probe, DC coupling
Resistance Load	Commercial	Capable of dissipating rated power (5000W) at 240 VAC or (10,000W) at 240 VAC.

resistance is 10 to 30 ohms. Reverse leads and verify resistance is infinite (as read on RX1 scale).

b. With negative voltage lead on collector,positive voltage lead on base, verify resistance is 10 to 30 ohms. Reverse leads and verify resistance is infinite (as read on the RX1 scale).

c. With base open verify that collector to emitter is infinite with both polarities of the multimeter.

NOTE

PNP transistors are check in the same manner, except that positive and negative leads are used in the reverse as described in previous steps.

5-23. Output Current Limit Adjustment.

5-24. To perform the current limit adjustment, proceed as follows:

1. Connect full resistive load to UPS.

2. Turn UPS on as in steps in Section 3-5.

3. Rotate overcurrent adjust potentiometer R132 on inverter circuit board in CW direction until a radical movement of the pointer in the Output Voltage Meter is observed, indicating the unit is in current limiting mode.

4. Rotate R132 CCW until the pointer in the Output Voltage Meter just stabilizes.

5. Remove and replace the full load to the output by alternately forward and reverse transfering the output. The instrument should not current limit. Turn both breakers OFF and remove load from output.

5-25. Undervoltage Adjustment.

5-26. To adjust the undervoltage shutdown circuit, proceed as follows:

1. Turn unit on. Follow procedure in Section 3-5.

2. Turn AC input breaker off. Unit is now operating on battery.

3. Observe that when the Battery Voltage meter reads 145 volts, the unit shuts down. If not, rotate undervoltage adjust potentiometer R132 of charger circuit board CCW to lower shutdown point.

5-27. REPAIR AND REPLACEMENT

5-28. Generally, if any parts are suspected of damage, they should be checked with multimeter for proper electrical values before reaplcement. The schematic and parts list are presented in Section VI as an aid in repairing the unit.

5-29. CIRCUIT BOARD ASSEMBLIES

5-30. The circuit board assemblies can either be repaired or replaced if parts or circuit board is damaged. De-energize the unit before removing any circuit board assembly. To remove circuit board, pull straight out on the circuit board, taking care not to damage circuit components. When reinstalling circuit board, carefully fit edge of circuit board in guide slots and press circuit board firmly in connector. Standard circuit board repair procedures are applicable.

5-31. FACTORY REPAIR

5-32. Do not replace factory-selected parts. Should it be necessary to return an instrument to the factory for repair, please contact Elgar Corporation Service Department for authorization to make shipment. DO NOT RETURN THE UNIT FOR REPAIR WITHOUT AUTHORIZATION.

TABLE 5-2. TROUBLESHOOTING CHART

Trouble	Probable Cause	Remedy
a. DC fuse blows when turned on or while operating	1. Shorted diode or SCR's in inverter	Switch UPS off. Test components with ohmmeter. Replace defective components.
	2. Shorted capacitors in AC output filter.	Visually inspect capacitors. Replace defective capacitors.
	3. Failure in inverter logic	Check output of inverter logic with oscilloscope.
b. DC fuse flows when AC output contactor is closed	1. Loose connection in AC output filter.	Check connection.
	2. SCR breakdown	Check SCR's with ohmmeter.
	3. Short in AC output filter.	Check AC output filter with ohmmeter.
c. DC voltage does not walk-in after CB1 is closed	1. Short on DC buss.	Check for short on DC buss with ohmmeter.
	2. Failure in charger logic.	Check with oscilloscope on the rectifier SCR. Replace the logic board.
	3. Defective input circuit breaker.	Check voltage on secondary side of circuit breaker.
	4. Shorted SCR or diode in charger	Check SCR's and diode with ohmmeter. Replace parts.
d. Input circuit breaker trips when closing.	1. Power walk-in does not work.	Check charger logic board. Replace components.
	2. Shorted diode or SCR in charger circuit.	Check components with ohmmeter. Replace components.
e. Battery circuit breaker cannot be closed or trips when unit is operating.	1. Check DC buss voltage for correct value.	Adjust DC buss.
	2. Check the undervoltage release on battery circuit breaker.	Replace DC circuit breaker

TABLE 5-2. TROUBLESHOOTING CHART (Cont'd)

Trouble	Probable Cause	Remedy
f. AC Power Off lamp fails to light. AC power is absent and Battery circuit breaker closed.	1. Lamp burned out.	Replace defective lamp.
	2. Lamp driver circuit in charger circuit board has malfunctioned.	Check charger board and replace defective components.
g. Battery Low lamp fails light. Undervoltage shutown has occurred.	1. Lamp burned out.	Replace defective lamp.
	2. Lamp Driver circuit in charger board has malfunctioned.	Check charger board and replace defective components.
h. Unit fails to shut down when battery output level drops to 145 volts.	1. Undervoltage circuit in charger board not correctly adjusted.	Adjust the undervoltage circuit as instructed in paragraph 5-25. Replace defective components as needed.
	2. Undervoltage turn-off transistor in inverter board has malfunctioned.	Check the undervoltage circuit in the inverter board.
i. Output voltage is lower or higher than 240 VAC. Both circuit breakers are closed.	1. Output voltage adjust-circuit in inverter board is not correctly adjusted.	Perform the output voltage adjustment as instructed in paragraph 5-11.

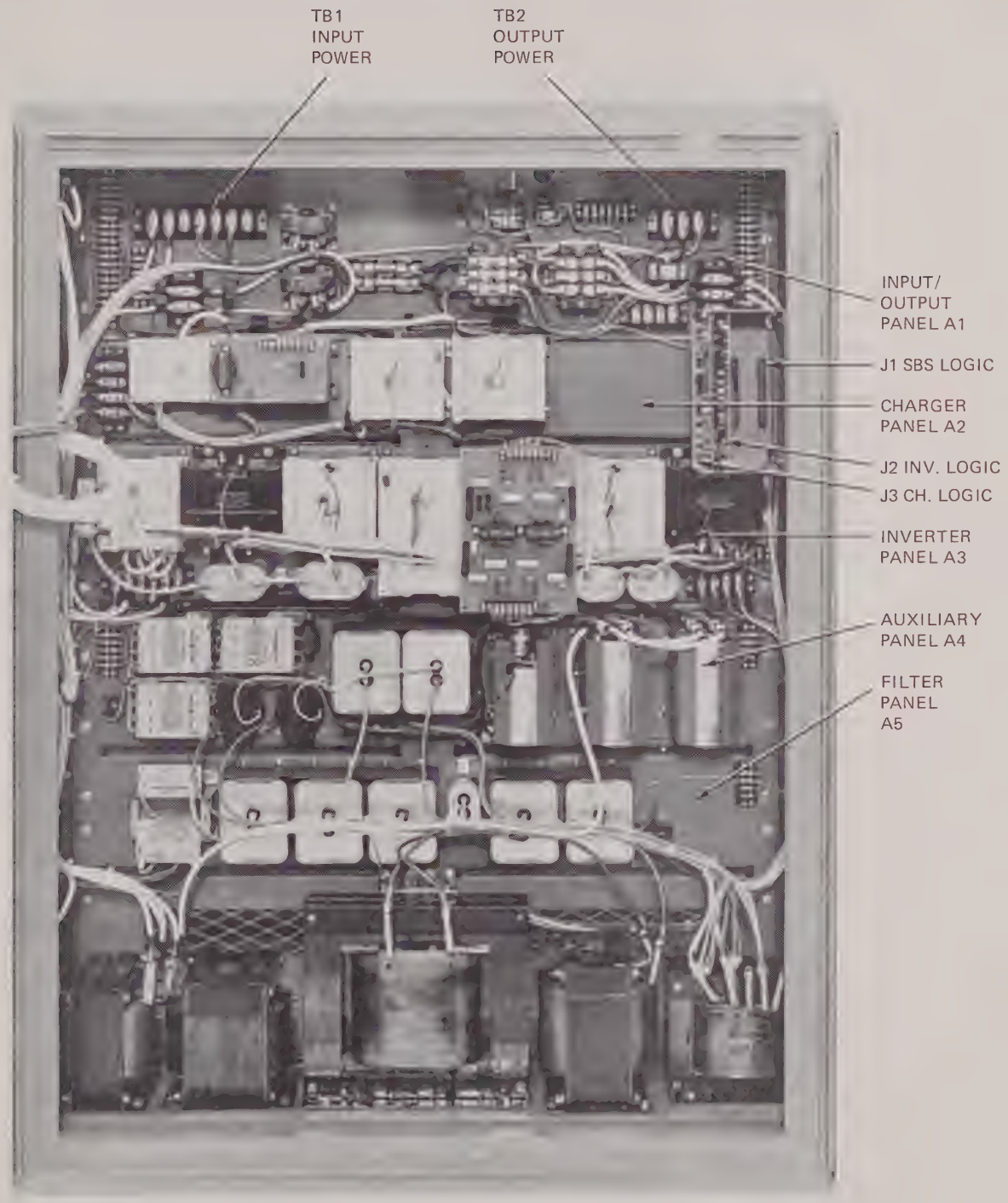
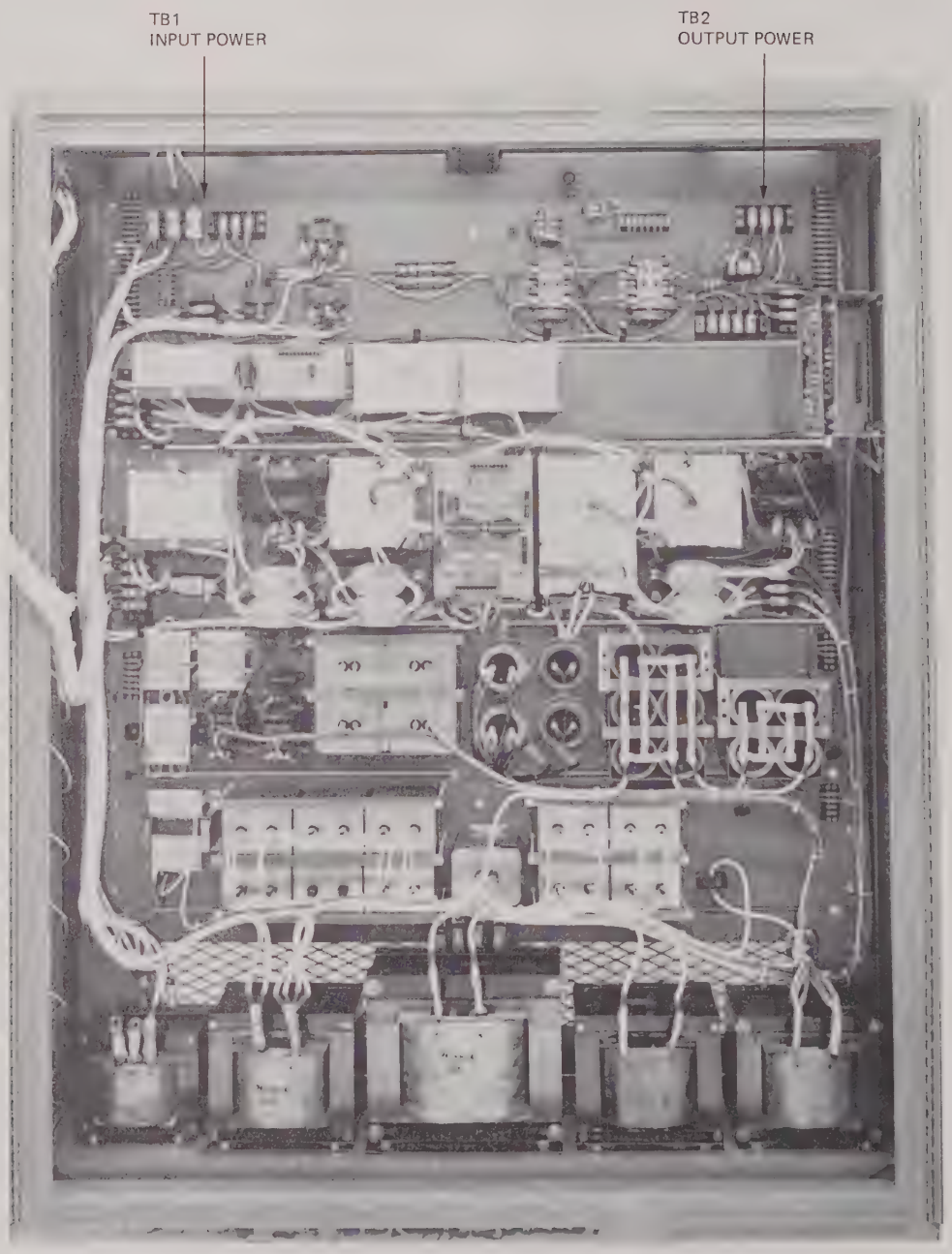


Figure 5-1. UPS 502-1, Inside View



(SAME AS 502-1)

Figure 5-2. UPS 103-1, Inside View

SECTION VI
DIAGRAMS

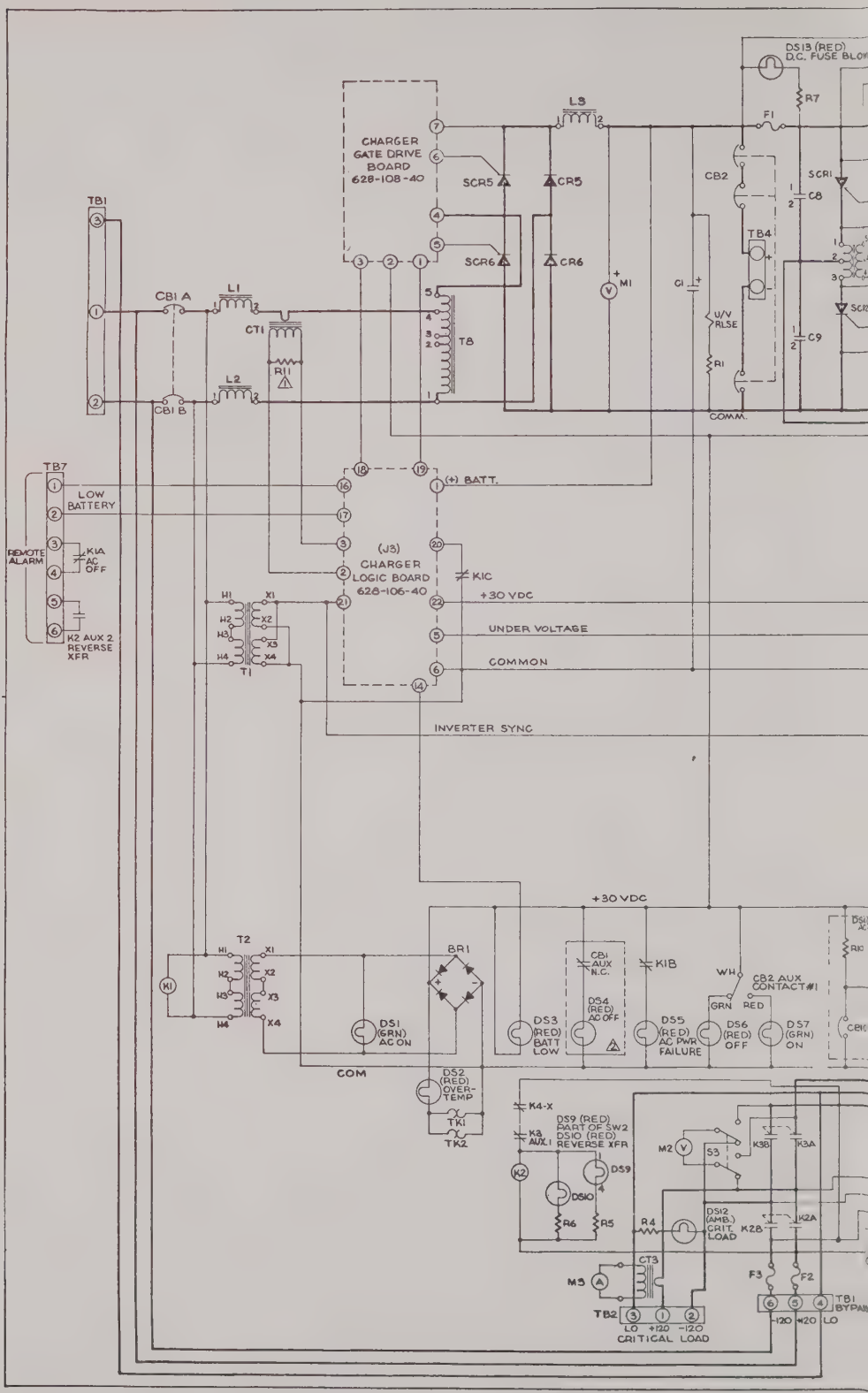
6-1. GENERAL

6-2. This section contains schematic diagrams and parts layout for all circuits in the UPS units. Schematic diagrams should be used to understand theory of operation, and as an aid during trouble-shooting. Reference designators shown on schematics correspond to reference designations shown in parts lists where exact component values are given.

6-3. DIAGRAMS AND PARTS LAYOUT

6-4. Diagrams included in this section are:

a. Overall Single Phase UPS Schematic
b. Parts Layout Charger Logic Board
c. Charger Logic Board Schematic
d. Parts Layout Charger Gate Drive
e. Charger Gate Drive Schematic
f. Parts Layout Inverter Logic Board
g. Inverter Logic Board Schematic
h. Parts Layout Inverter Gate Drive
i. Inverter Gate Drive Schematic


DS13 (RED) D.C. FUSE BLOW
R7
F1
L3
CHARGER GATE DRIVE BOARD 628-108-40
SCR5
CR5
SCR6
CR6
CB2
SCR1
C8
TB4
M1
C1
U/V RLSE
R1
C9
COMM.
TB1
CB1 A
CB1 B
L1
L2
CT1
R11
T8
TB7
LOW BATTERY
REMOTE ALARM
K1A AC OFF
K2 AUX 2 REVERSE XFR
(+) BATT.
(J3) CHARGER LOGIC BOARD 628-106-40
K1C
+30 VDC
UNDER VOLTAGE
COMMON
INVERTER SYNC
T1
T2
BR1
K1
+30 VDC
CB1 AUX N.C.
K1B
WH
CB2 AUX CONTACT #1
GRN
RED
DS1 (GRN) AC ON
DS3 (RED) BATT LOW
DS4 (RED) AC OFF
DS5 (RED) AC PWR FAILURE
DS6 (RED) OFF
DS7 (GRN) ON
COM
DS2 (RED) OVER-TEMP
TK1
TK2
K4-X
K3 AUX.1
DS9 (RED) PART OF SW2
DS10 (RED) REVERSE XFR
K2
DS9
DS10
R6
R5
R4
DS12 (AMB.) CRIT. LOAD
K2B
K2A
K3B
K3A
M2
S3
CT3
M3
F3
F2
TB2
LO +120 -120
CRITICAL LOAD
-120 +120 LO

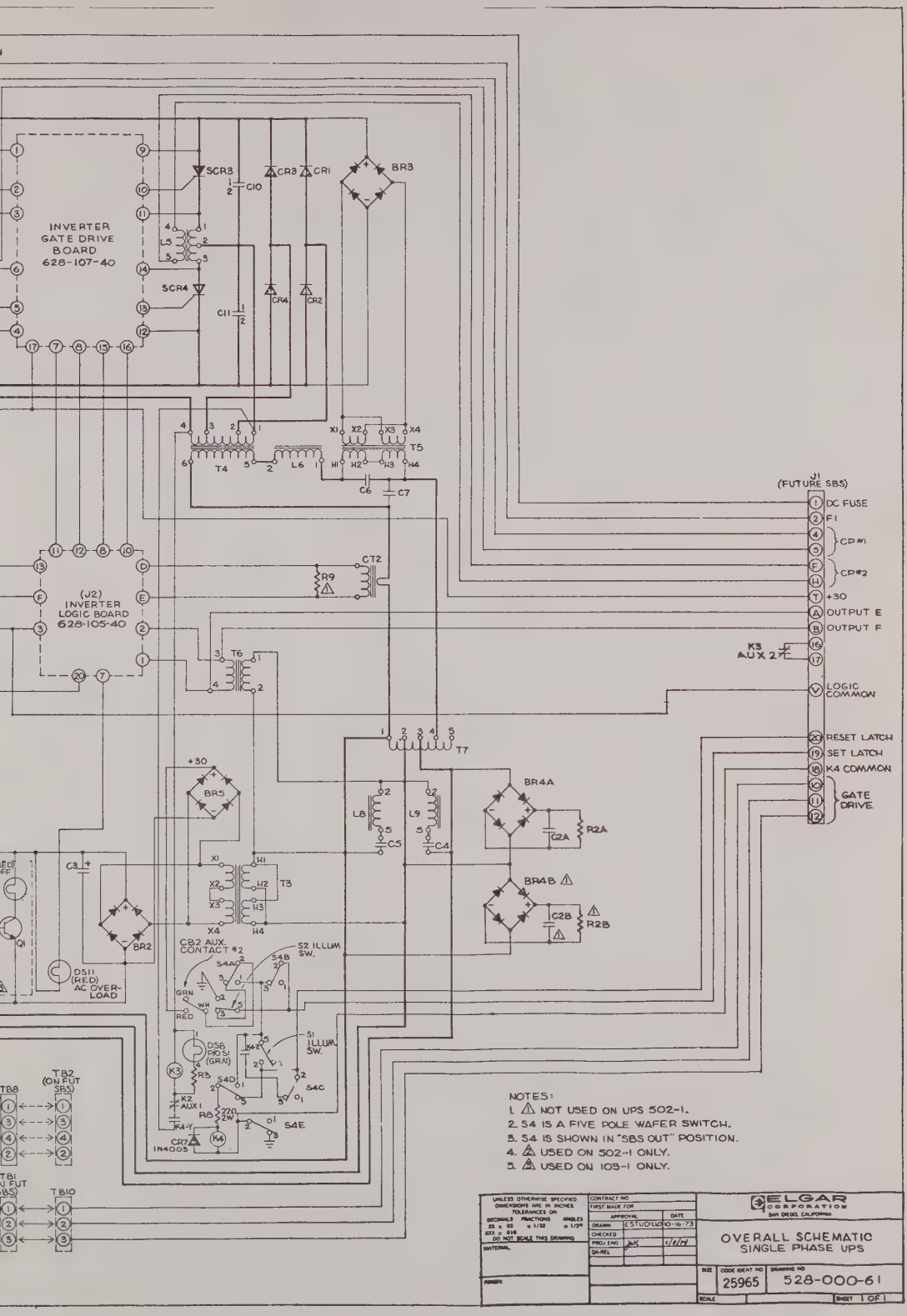


Figure 6-1. Overall Single Phase UPS Schematic

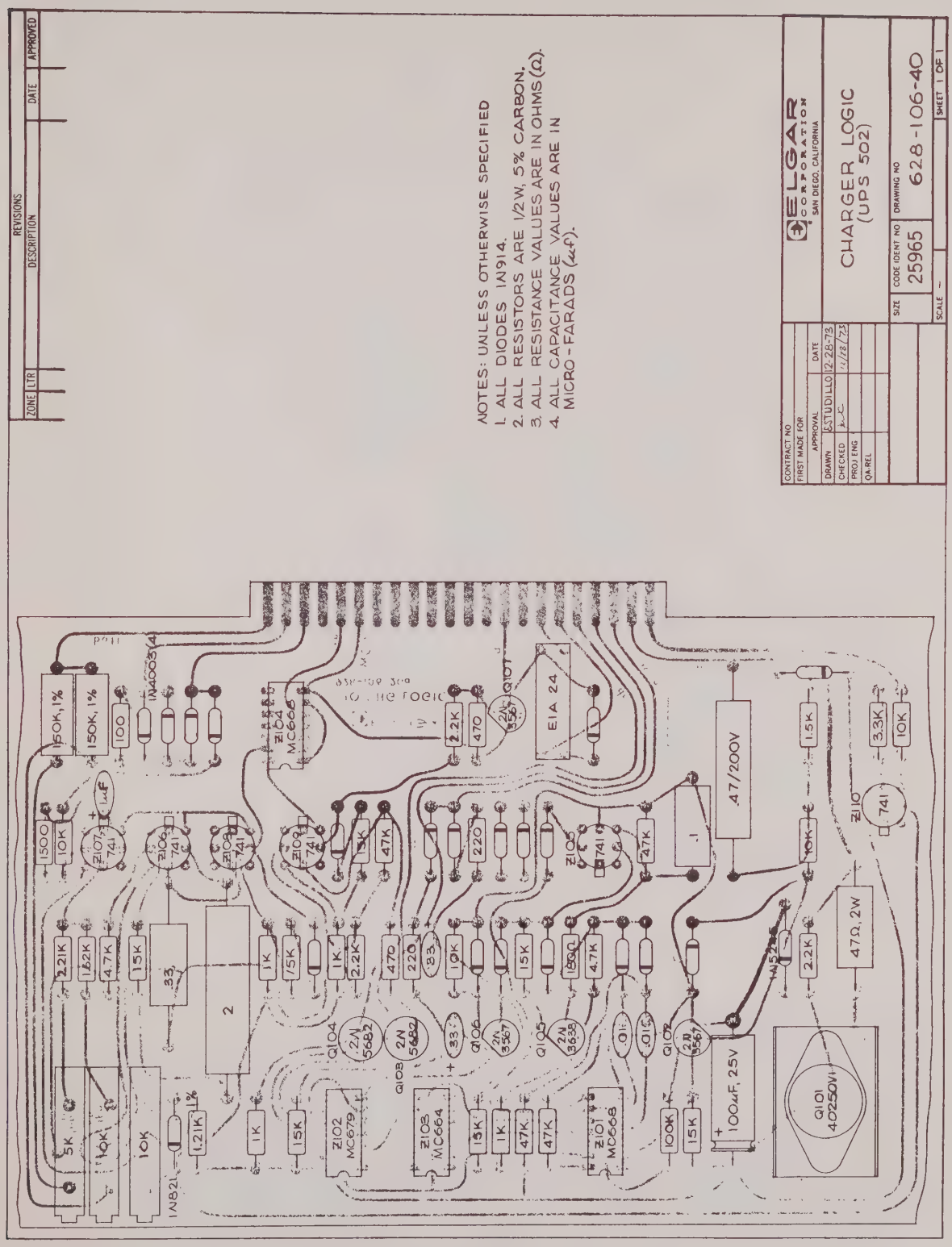
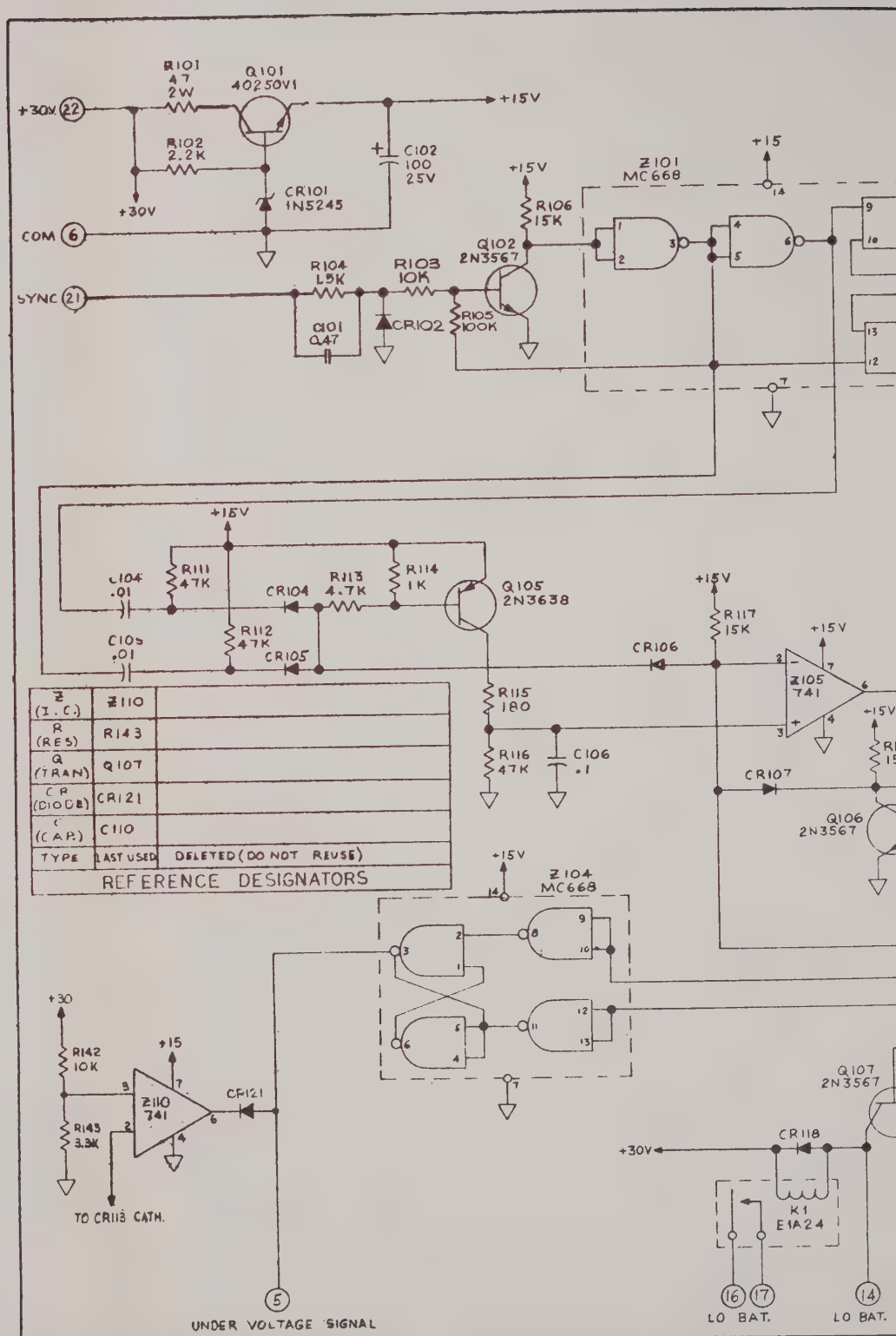


Figure 6-2. Parts Layout, Charger Logic Board.



Z (I.C.)	Z110	
R (RES)	R143	
Q (TRAN)	Q107	
CR (DIODE)	CR121	
C (CAP.)	C110	
TYPE	LAST USED	DELETED (DO NOT REUSE)

REFERENCE DESIGNATORS

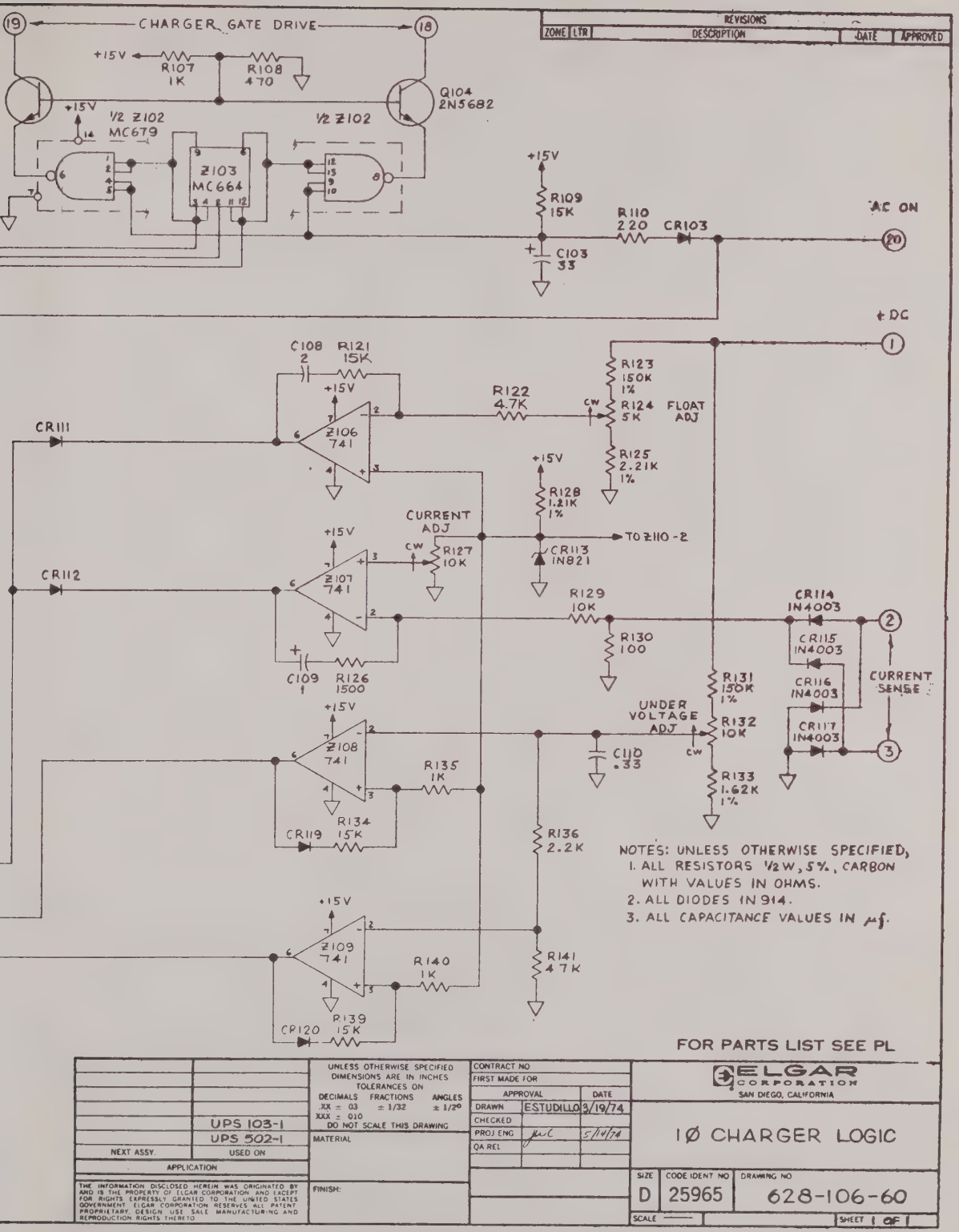


Figure 6-3. Charger Logic Board Schematic

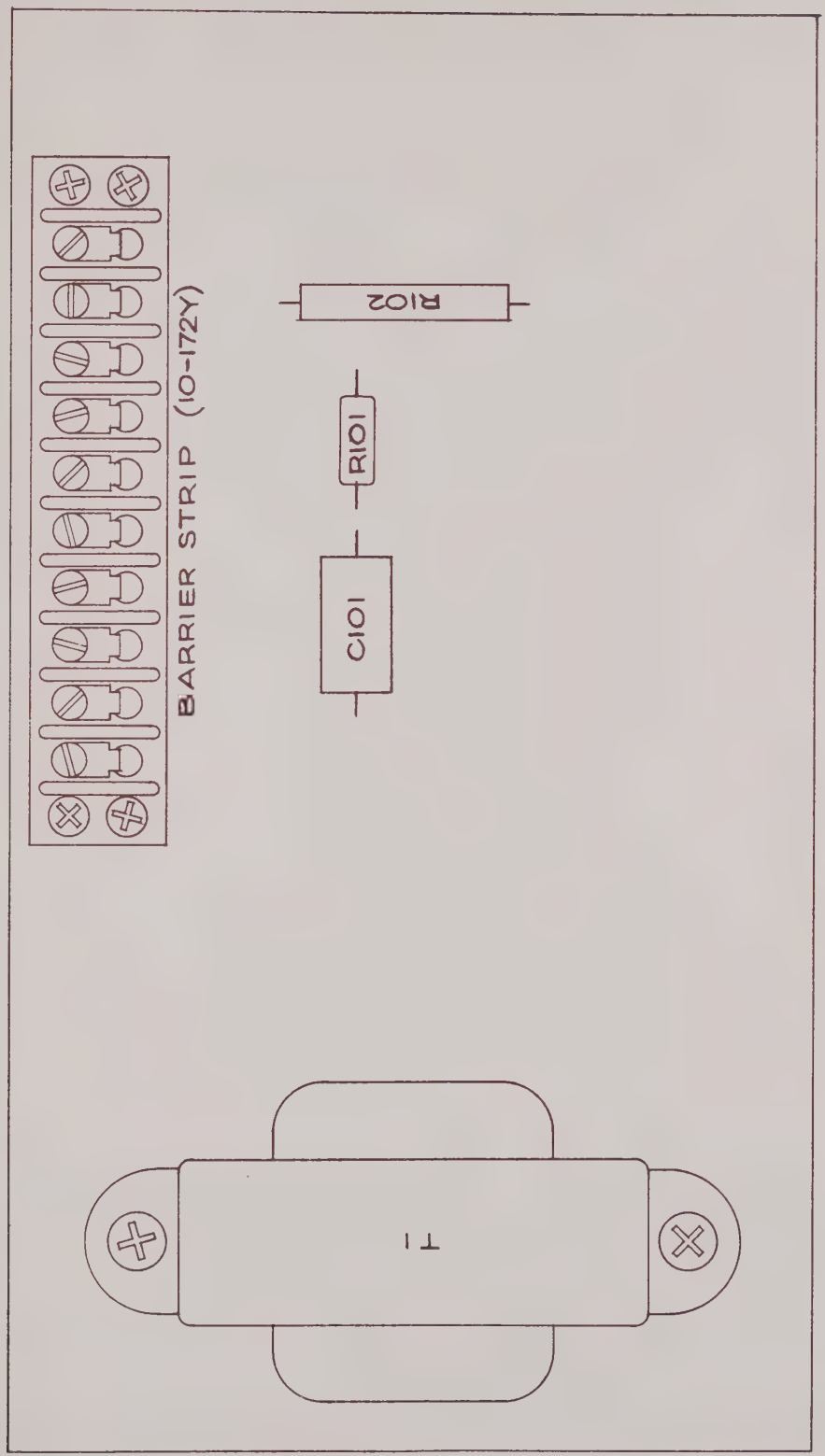
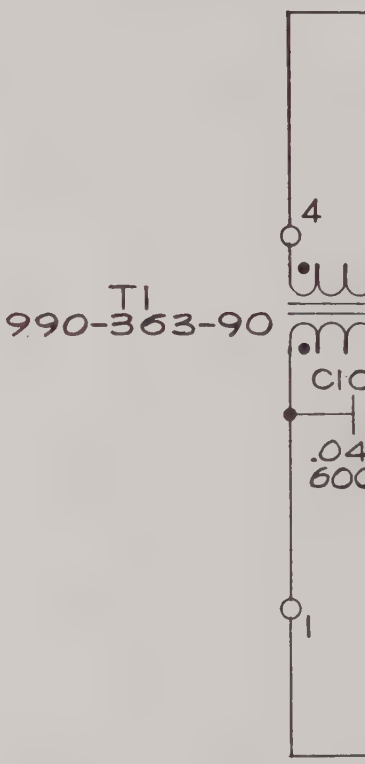


Figure 6-4. Parts Layout Charger Gate Drive

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



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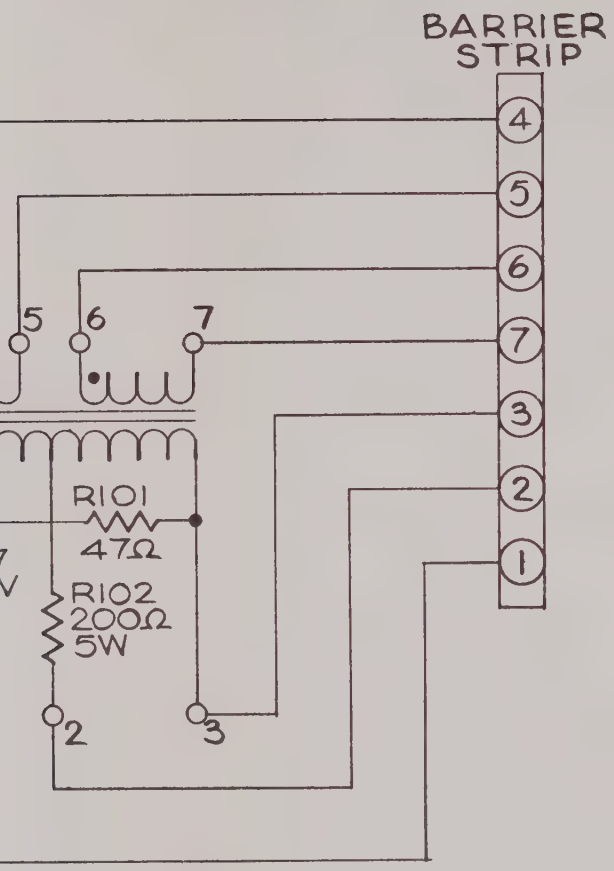


02-1	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ON: DECIMALS FRACTIONS ANGLES .XX ± .03 ± 1/32 ± 1/2° .XXX ± .010 DO NOT SCALE THIS DRAWING	CONTRACT NO. FIRST MADE FOR: APPROVAL DATE DRAWN ESTUDILLO 3/25/74 CHECKED PROJ ENG JWC 5/10/74 QA-REL	ELGAR CORPORATION SAN DIEGO, CALIFORNIA
	MATERIAL:		1Ø CHARGER GATE DRIVE
	FINISH:		SIZE B · CODE IDENT. NO. 25965 · DRAWING NO. 628-108-60 · SCALE — · SHEET 1 OF 1

Figure 6-5. Charger Gate Drive Schematic

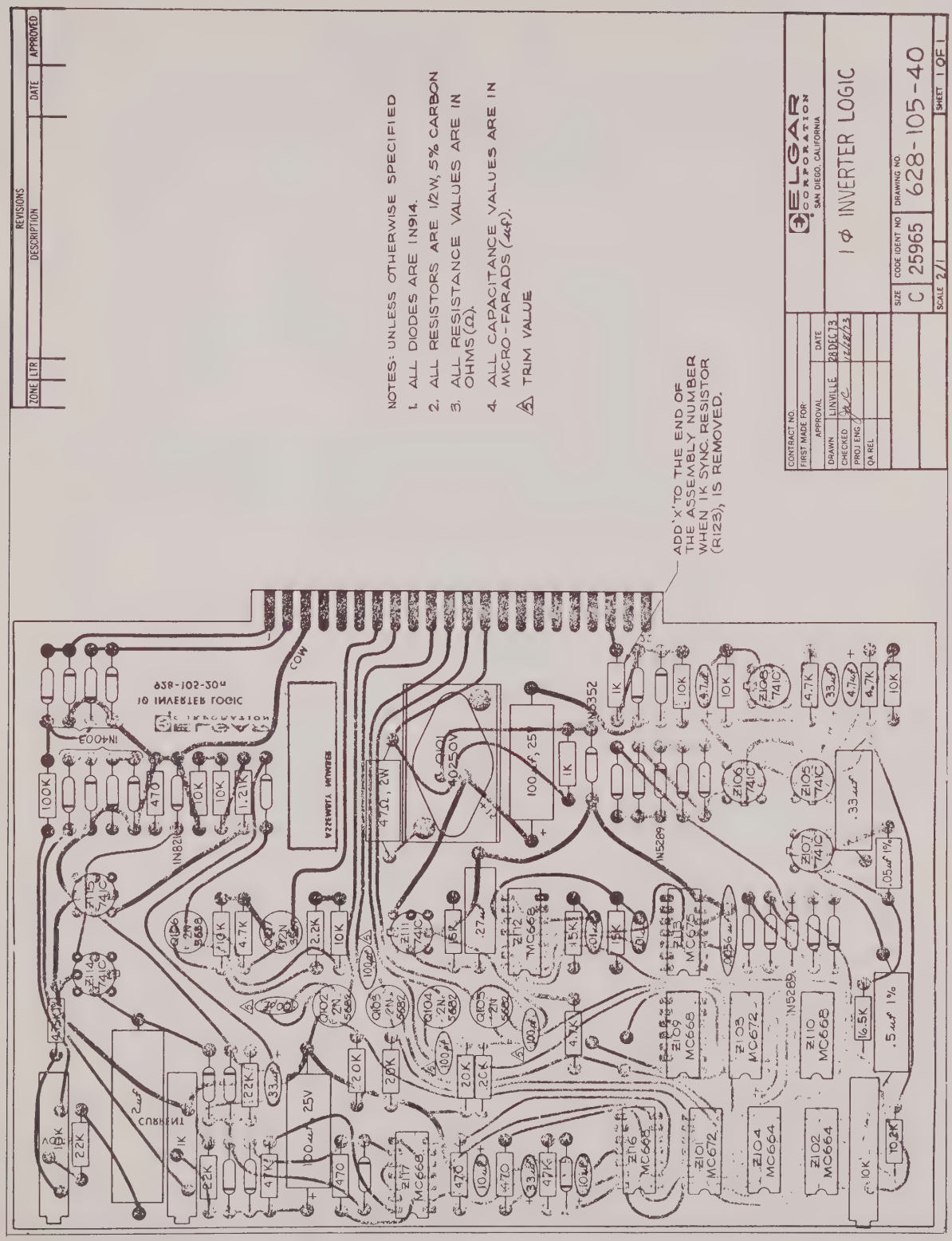
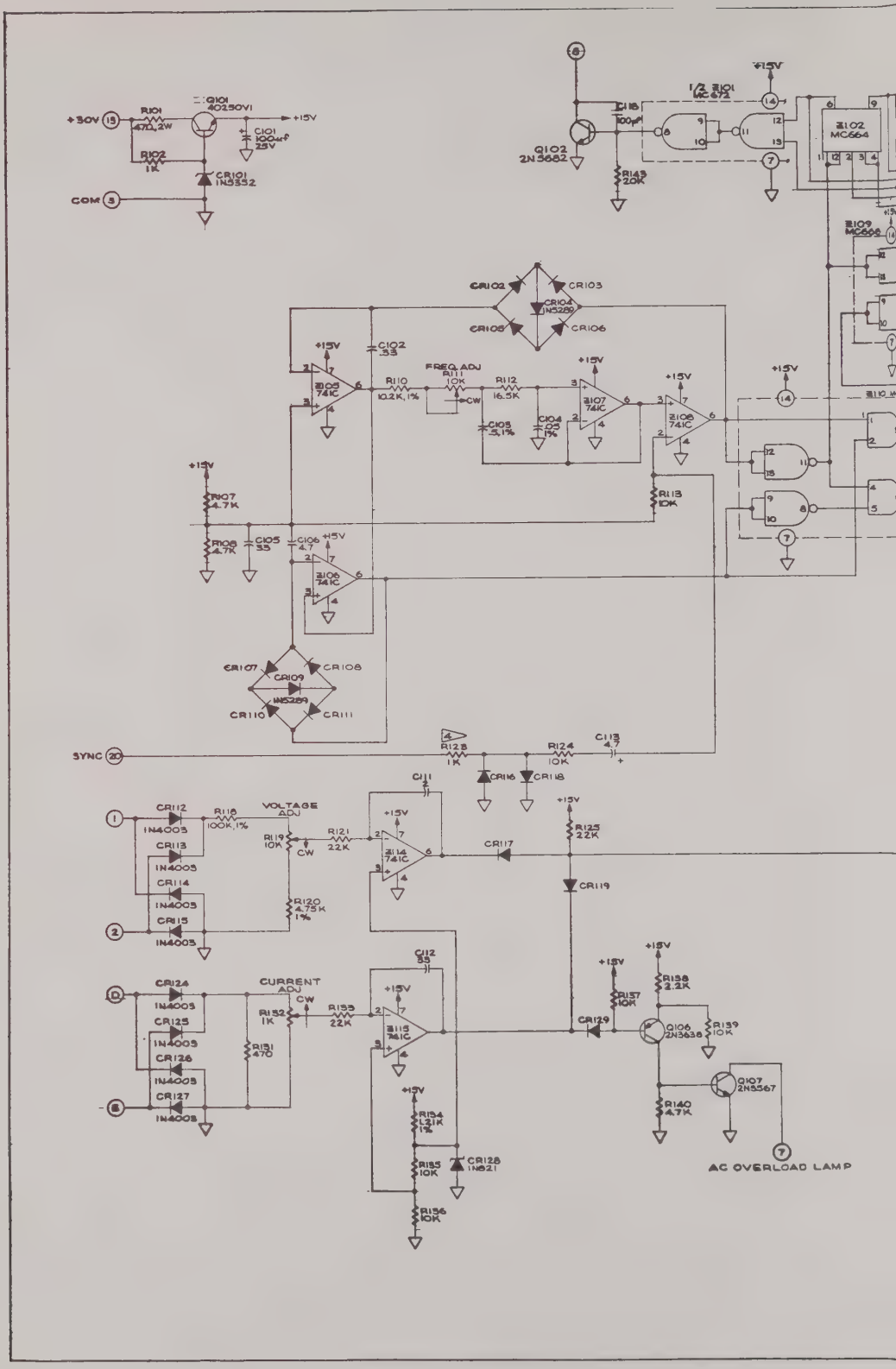


Figure 6-6. Parts Layout, Inverter Logic Board.


+30V
COM
R101
470Ω,2W
R102
1K
Q101
40250VI
C101
100μF
25V
+15V
CR101
IN5352
Q102
2N3682
C115
100pF
1/4 Z101
MC672
Z102
MC664
R143
20K
Z109
MC666
CR102
CR103
CR104
IN5289
CR105
CR106
Z103
741C
C102
.33
FREQ ADJ
R111
10K
R110
10.2K,1%
CW
R112
16.5K
C103
.33,1%
C104
.05
1%
Z107
741C
Z108
741C
R113
10K
R107
4.7K
R109
4.7K
C105
.33
C106
4.7
Z106
741C
CR107
CR108
CR109
IN5289
CR110
CR111
SYNC
R123
1K
R124
10K
C113
4.7
CR116
CR118
C111
CR112
IN4003
CR113
IN4003
CR114
IN4003
CR115
IN4003
R118
100K,1%
VOLTAGE
ADJ
R119
10K
CW
R121
22K
Z114
741C
R120
4.75K
1%
CR117
R125
2.2K
CR119
C112
.33
CR124
IN4003
CR125
IN4003
CR126
IN4003
CR127
IN4003
CURRENT
ADJ
R132
1K
CW
R133
22K
Z115
741C
R131
470
R137
10K
R138
2.2K
CR129
Q106
2N3638
R139
10K
Q107
2N5367
R140
4.7K
AC OVERLOAD LAMP
R134
1.31K
1%
R135
10K
CR128
IN821
R136
10K

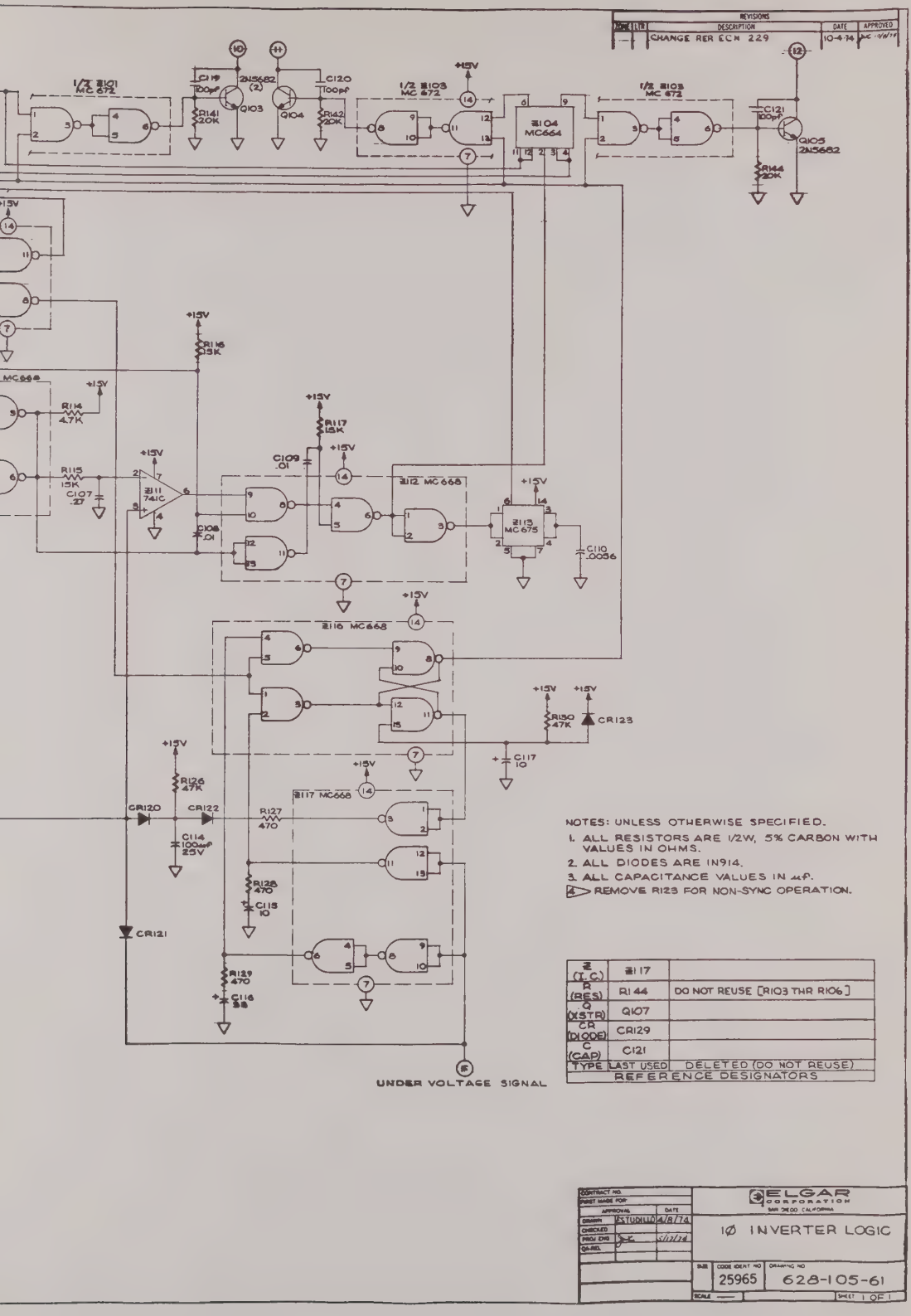
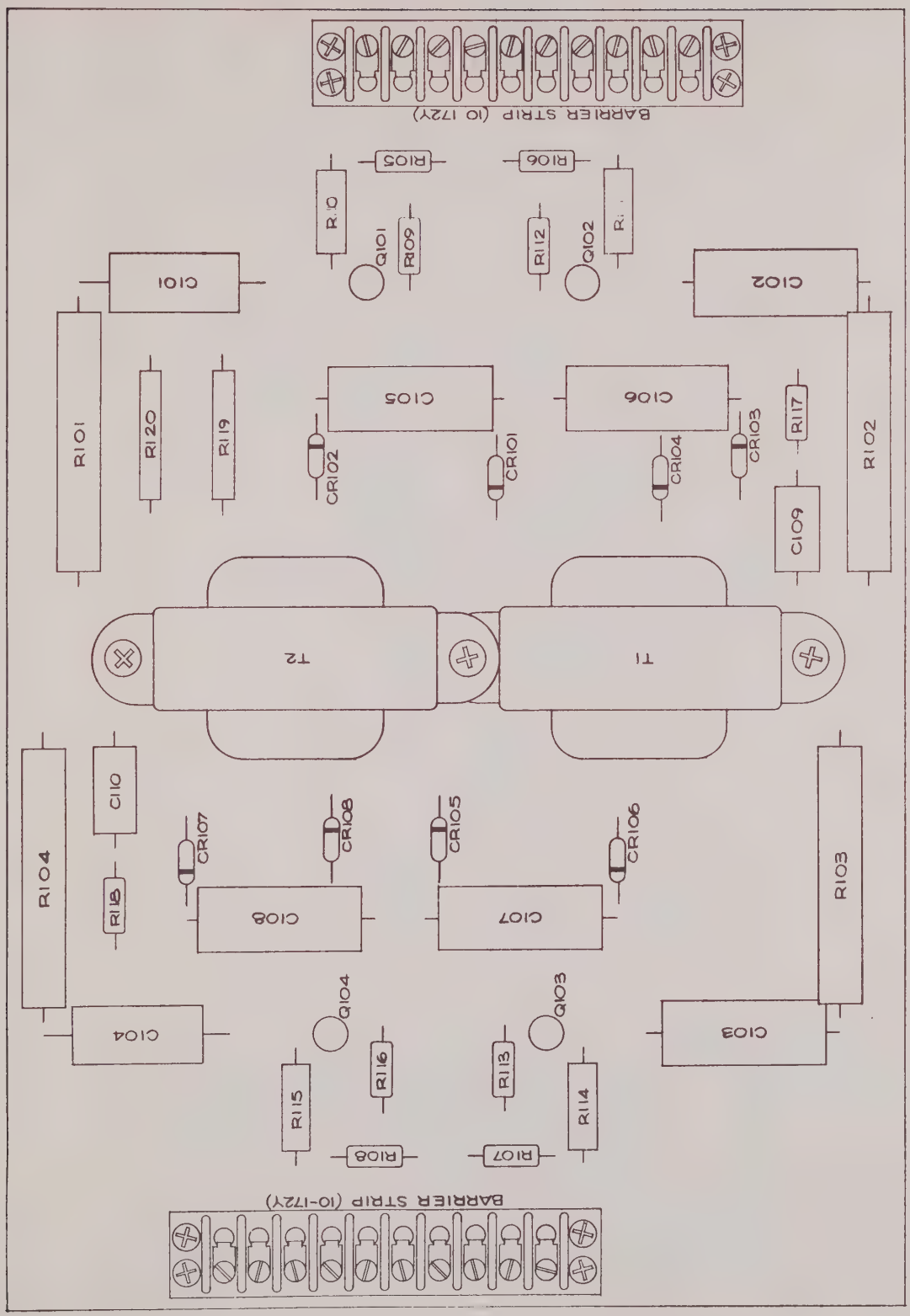


Figure 6-7. Single Phase Inverter Logic Board Schematic



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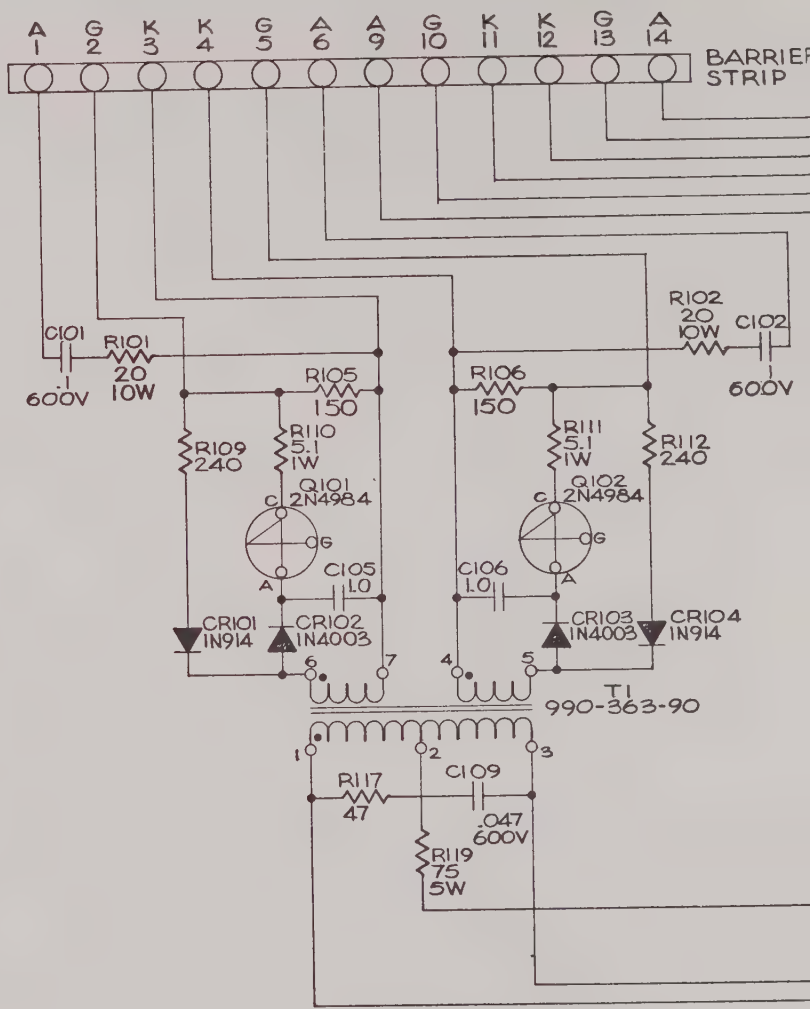
GATE DRIVER

628-107-40

Figure 6-8. Parts Layout Inverter Gate Drive



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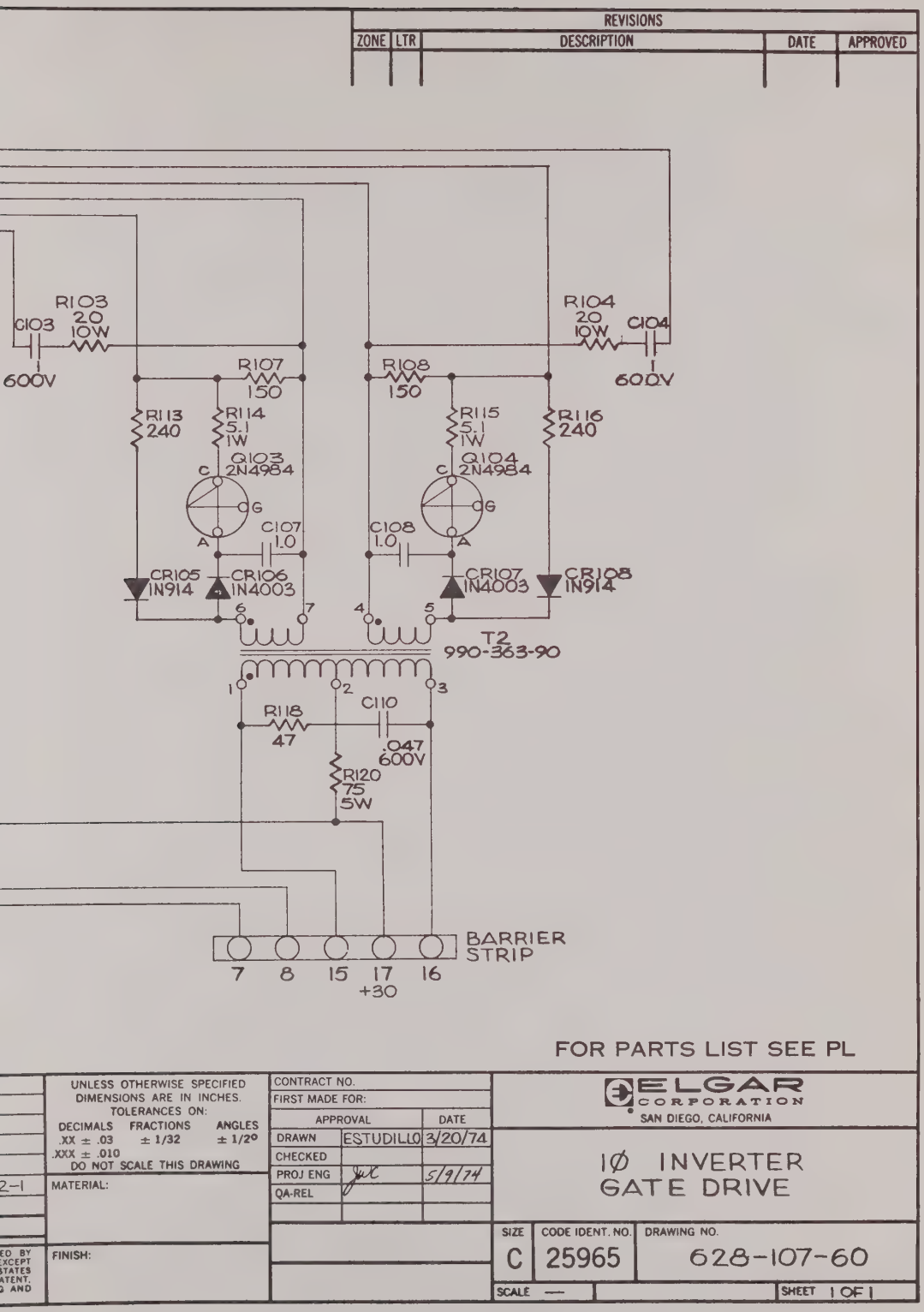


Figure 6-9. Single Phase Inverter Gate Drive Schematic

SECTION VII
PARTS LIST

7-1. GENERAL

7-2. This section contains a listing of all parts necessary for factory-authorized repair of the UPS units. Location of parts and assemblies is given on an illustration accompanying each parts list. Parts are located on the illustrations and correlated on the parts list by reference designators.

7-3. When ordering spare parts, specify part name, part number, manufacturer, component value and Elgar part number. Where no specific manufacturer or part number is given, the replacement part should conform to value, rating, and tolerance as listed. If complete assemblies are desired, order assemblies from Elgar Corporation, 8225 Mercury Court, San Diego, California, 92111. Specify assembly number, instrument series number and instrument name.

UPS 502-1 CHASSIS PARTS LIST

SCHEMATIC DESIGNATION	VALUE	DESCRIPTION OR TYPE	RATING	MANUFACTURER NAME	MANUFACTURER PART NUMBER	ELGAR PART NUMBER
T4		Summing Trans.		Elgar		990-475-90
T7		Output Auto Trans.		Elgar		990-359-90
T8		Input Auto Trans.		Elgar		990-476-90
L3		DC Choke		Transrex	12006	990-354-90
L6		AC Series React.		Elgar		990-356-90
INPUT/OUTPUT ASSY. No. 1						
S4		Switch		CTS	T209	860-T20-9X
TB1		Terminal Blk		Kulka	604-7	893-604-7X
TB2		Terminal Blk		Kulka	604-3	893-604-3X
TB3		Terminal Blk		Kulka	601-22	893-601-22
TB4		Terminal Blk		Kulka	601-6	893-601-6X
TB5		Terminal Blk		Kulka	604-2 T.S. 869	893-604-2X
TB6		Terminal Blk		Kulka	601-6	893-601-6X
TB7		Terminal Blk		Kulka	604-4	893-604-4X
TB8		Terminal Blk		Kulka	604-3	893-604-3X
TB9		Terminal Blk		Kulka	601-22	893-601-22
TB10		Terminal Blk		Torr.	12157	990-137-90
CT1		C.T.		Cutube	KSR-60	850-KSR-60
CT3		Output Cur. C.T.		Elgar		990-355-92
L1, L2		RFI Inductor			W88AX36	861-833-AX
K1		Control Relay				861-320-AB
K2		Bypass Cont.	220V Coil			861-320-AA
K3		Bypass Cont.	110V Coil			861-92D-91
K4		Control Relay	24V DC	RBM	92D-913	804-220-05
R8	22 ohm	Resistor	2W, 5%	Dale	RC42GF220J	845-400-3X
CR7		Diode		Commercial	1N4003	858-BAF-30
F2, F3		Fuse	30 Amp		BAF30	
CHARGER PANEL ASSY. No. 2						
TB2		Terminal Blk		Kulka	604-4	893-604-4X
TB3		Terminal Blk		Kulka	601-4	893-601-4X
CR5, CR6		Diode		IR	70H60A	845-706-0A

UPS 502-1 CHASSIS PARTS LIST (Continued)

SCHEMATIC DESIGNATION	VALUE	DESCRIPTION OR TYPE	RATING	MANUFACTURER		ELGAR PART NUMBER
				NAME	PART NUMBER	
SCR5		SCR				846-C15-2M
SCR6		SCR				846-C15-2M
INVERTER PANEL ASSY. No. 3						
TB2				Kulka	604-6	893-604-6X
TB3				Kulka	604-4	893-604-4X
TB4				Kulka	604-12	893-601-12
F1		DC Fuse	70 Amp		KAB70	858-KAB-70
C8, C9	40 uf	Comm Cap.	300V	G.E.	28F5117FC	827-406-23
C10, C11	20 uf	Comm Cap.	400V	G.E.	28F5115FC	827-206-GE
CR1,CR3		Rectifier		IR	70H60A	845-706-0A
CR2,CR4		Rectifier		IR	70HR60A	845-706-3R
SCR1, SCR2, SCR3, SCR4		SCR		G.E.	C156D	846-C15-6D
TK1, TK2		Thermostat		Thermo	3400	861-340-0X
L4, L5		Comm. Reactor		Elgar		990-472-90
AUX. PANEL ASSY. No. 4						
TB1		Terminal Blk		Kulka	601-6	893-601-6X
TB2		Terminal Blk		Kulka	601-4	893-601-4X
T1,T2,T3		Transformer		G.E.	9T56Y2873	850-T28-73
T6		Transformer		Aztec	11896	990-151-90
C1, C2	5400 uf	DC Cap.	.200V		86F207	826-548-X2
C3	22000 uf	Clipper Cap.	50V		36D223G050DLZA	826-229-11
C4, C5	50 uf	Harmonic Cap.	330V	KGDX	3500	825-K35-00
L8, L9		Harmonic Reactor		Elgar		990-438-XX
BR1, BR2		P.S. Bridge		Motorola	MDA-990-3	847-990-3X
BR4, BR5		S.C. Bridge		Motorola	MDA-990-6	847-990-6X
R2	1.5K	S.C. Resistor	50W	Dale	RH50	810-152-05

UPS 502-1 CHASSIS PARTS LIST (Continued)

SCHEMATIC DESIGNATION	VALUE	DESCRIPTION OR TYPE	RATING	MANUFACTURER		ELGAR PART NUMBER
				NAME	PART NUMBER	
FILTER PANEL ASSY. No. 5						
TB1		Terminal Blk		Kulka	601-4	893-601-4X
T5		Sht Circuit Xfmr		G.E.	9T56Y2810	850-T28-10
C6A,6B,6C,7A,7B	50 uf	Ser.Cap.,Shunt Cap	330V	CD	KGDX-3500	825-K35-00
C6D	20 uf	Series Cap.	370V	GE	45F171	825-206-24
BR3		Clipper Bridge		Motorola	MDA-990-6	847-990-6X
CT2		Control C.T.		Torr.	12152	990-137-90
FRONT PANEL ASSY.						
M1	0-200	Voltmeter	VDC	Jewell	MS2T	857-200-2T
M2	0-300	Voltmeter	VAC	Jewell	MS2T	857-300-2T
M3	0-50	Ammeter		Jewell	MS2AC	857-50A-S2
S1, S2		Pushbutton Sw.		Dialco	513-1601-604	854-513-16
S3		V.M. Sw.		JBT	JMT234	860-JMT-24
DS1-DS13		Lamp		IEE	327	854-327-93
TB1		Terminal Strip	10 Pin			893-170-10
CB2		Ckt. Bkr.		G.E.	TED 13450 WL	852-U53-GE
R1	5.6K	Resistor	2W, 5%	Speer	RC42GF	804-562-05
R3, R4	2.2K	Resistor	5W	Dale	CW5	807-222-05
R5, R6	4K	Resistor	10W	Dale	CW10	808-402-05
R7	6K	Resistor	10W	Dale	CW10	808-602-05
Red lamp lens		Red		Eldema	RA220RT	854-220-21
Green lamp lens		Green		Eldema	RA220GT	854-220-51
Amber lamp lens		Amber		Eldema	RA220AT	854-220-41
CB1		Ckt. Bkr.		Heinman	CD2A2602403	852-603-CD

UPS 103-1 CHASSIS PARTS LIST

SCHEMATIC DESIGNATION	VALUE	DESCRIPTION OR TYPE	RATING	MANUFACTURER		ELGAR PART NUMBER
				NAME	PART NUMBER	
T4		Summing Xfmr		Elgar		990-434-90
T7		Out. Auto Xfmr		Elgar		990-432-90
T8		Inp. Auto Xfmr		Elgar		990-433-90
L3		D.C. Choke		Elgar		990-430-90
L6		AC Series React.		Elgar		990-431-90
INPUT/OUTPUT ASSY. No. 1						
TB1-A		Terminal Blk		Kulka	CR2960SY139C3D	
TB2, TB1-B		Terminal Blk			604-3	893-604-3X
TB3		Terminal Blk		Kulka	601-22	893-601-22
TB4		Terminal Blk		Kulka	601-6	893-604-6X
TB5		Terminal Blk		Kulka	604-2	893-604-2X
TB6		Terminal Blk			TS-689	
TB7		Terminal Blk		Kulka	601-6	893-601-6X
TB8		Terminal Blk		Kulka	604-4	893-604-4X
TB9		Terminal Blk		Kulka	604-3	893-604-3X
TB10		Terminal Blk		Kulka	601-22	893-601-22
L1, L2		Choke		Elgar		990-487-XX
CT1		C.T.		Torr	13351	990-507-XX
CT3		Out. Current C.T.		Cutube	KSR60	850-KSR-10
K1		Control Relay			W88AX36	861-833-XX
K2		Bypass Contactor	220V Coil			861-620-BA
K3		Out. Contactor	110V Coil			861-620-AA
K4		Control Relay		RBM	92D913	861-92D-91
R8	22 ohm	Resistor	2W, 5%	Speer	RC42GF220J	804-220-05
CR7					1N4003	845-400-3X
F2, F3		Fuse	60 Amp			858-SC6-0A
S1		SBS Select Sw.				
CHARGER PANEL ASSY. No. 2						
TB2		Terminal Blk		Kulka	604-4	893-604-4X
TB3		Terminal Blk		Kulka	601-4	893-601-4X
CR5, CR6		Diode		G.E.	1N3293	845-329-3X
SCR5, SCR6		SCR			C152M	846-C15-2M

UPS 103-1 CHASSIS PARTS LIST (Continued)

SCHEMATIC DESIGNATION	VALUE	DESCRIPTION OR TYPE	RATING	MANUFACTURER		ELGAR PART NUMBER
				NAME	PART NUMBER	
INVERTER PANEL ASSY. No. 3						
TB2		Terminal Blk		Kulka	604-6	893-604-6X
TB3		Terminal Blk		Kulka	604-4	893-604-4X
TB4		Terminal Blk		Kulka	601-12	893-601-12
F1		DC Fuse	150 Amp	Bussman	KAB150	858-KA1-50
C8, C9, C10, C11	40 uf	Comm. Cap	300V	G.E.	28F5117FC	827-406-23
CR1, CR2, CR3,CR4		Diode		G.E.	1N3293R	845-329-3R
SCR1, SCR2, SCR3, SCR4		SCR		G.E.	C185D	846-C18-5D
TK1, TK2		Thermostat		Thermo	3400	861-340-0X
L4, L5		Comm. Reactor		Elgar		990-435-91
AUX. PANEL ASSY. No. 4						
TB1		Terminal Blk		Kulka	601-6	893-601-6X
TB2		Terminal Blk		Kulka	601-4	893-601-4X
T1		Sync Xfmr		G.E.	9T56Y2873	850-T28-73
T2, T3		Pwr. Supply Xfmr		G.E.	9T56Y2873	850-T28-73
C1	5400 uf	D.C. Cap	200V	G.E.	86F207	826-548-X2
C2A, C2B	5400 uf	Clipper Cap	200V	G.E.	86F207	826-548-X2
C3A, C3B	23200 uf	Capacitor	50V	G.E.	86F170M1	826-239-12
C4A, C4B	50 uf	Harmonic Cap	330V	CD	KGDX-3500	
C5A, C5B						
L8, L9		Harmonic Reactor		Elgar		990-443-91
BR1, BR2		P.S. Bridge		Motorola	MDA990-3	847-990-3X
BR4A, BR4B, BR5		S.C. Bridge		Motorola	MDA990-6	847-990-6X
R2A, R2B	1.5K	S.C. Resistor	50W	Dale	RH50	810-152-05
T6		Sense Xfmr		Aztec	11896	990-151-90
FILTER PANEL ASSY. No. 5						
TB1		Terminal Blk		Kulka	601-4	893-601-4X
T5		Short Ckt. Xfmr		G.E.	9T56Y2810	850-T28-10
C6A-C6G	50 uf	Series Cap	330V	CD	KGDX-3500	825-K35-XX

UPS 103-1 CHASSIS PARTS LIST (Continued)

SCHEMATIC DESIGNATION	VALUE	DESCRIPTION OR TYPE	RATING	MANUFACTURER		ELGAR PART NUMBER
				NAME	PART NUMBER	
C7A-C7D	50 uf	Shunt Cap	330V	C.D.	KGDX-3500	825-K35-XX
BR3		Clipper Bridge		Motorola	MD990-6	847-990-6X
CT2		Control C.T.		Torr	12152	990-137-90
FRONT PANEL ASSY.						
M1	0-200	Voltmeter	VDC	Jewell	MS2T	857-200-2T
M2	0-300	Voltmeter	VAC	Jewell	MS2T	857-300-2T
M3	0-50	Ammeter		Jewell	MS2AC	857-504-52
S1, S2		Pushbutton Sw.		Dialco	513-1601-604	854-513-16
S3		V.M. Sw.		JBT	JMT 234	860-JMT-24
DS1-DS13		Lamp		IEE	327	854-327-93
TB1		Terminal Blk	10 Pin			843-170-10
CB2		Ckt Bkr		G.E.	TED134100WL	852-UPS-10
R1	5.6K	Resistor	2W, 5%	Speer	RC42GF	805-562-05
R3, R4	2.2K	Resistor	5W	Dale	CW5	807-222-05
R5, R6	6K	Resistor	10W	Dale	CW10	808-602-05
R7	4K	Resistor	10W	Dale	CW10	808-402-05
Red lamp lens		Red		Eldema	RA220RT	854-220-21
Grn lamp lens		Green		Eldema	RA220GT	854-220-51
Amber lamp lens		Amber		Eldema	RA220AT	854-220-41
CB1		Ckt Bkr		Heineman	CJ3G3U125-3	852-CJ3-G3
Lamp Driver Bd				Elgar		928-112-20

UPS 502-1 & UPS 103-1 INVERTER LOGIC BD ASSY. 628-105-40

SCHEMATIC DESIGNATION	VALUE	DESCRIPTION OR TYPE	RATING	MANUFACTURER		ELGAR PART NUMBER
				NAME	PART NUMBER	
C101, C114	100 uf		25V	Sprague	500D107G025DD7	824-107-51
C102	.33 uf		200V, 5%	IMB	ZA2C334J	822-334-53
C103	.5 uf		100V, 1%	IMB	BA1B504F	822-504-11
C104	.05 uf		100V, 1%	IMB	BA1B503F	822-503-11
C105, C112, C116	33 uf		25V	Sprague	196D336X0025LA3	823-336-51
C106, C113	4.7 uf		35V	Sprague	196D475X0035JA1	823-475-61
C107	.27 uf		100V, 1%	IMB	BA1B274F	822-274-11
C108, C109	.01 uf			Centralab	DDM103	821-103-00
C110	.0056 uf		10%	Centralab	DDM562	821-562-00
C111	2 uf		200V, 1%	IMB	ZA2C205F	822-205-53
C117, C115	10 uf		50V	Sprague	500D106G050CB7	824-106-71
C118, C119, C120	FSV					
C121						
CR101		Zener Diode		Motorola	1N5352	843-535-2X
CR102,CR103, CR105,CR106, CR107,CR108, CR110,CR111. CR116,CR117, CR118,CR119, CR120,CR121, CR122,CR123, CR129		Diode		Commercial	1N914	844-914-XX
CR104,CR109		Zener		Motorola	1N5289	843-528-9X
CR112,CR113, CR114,CR115, CR124,CR125, CR126,CR127		Diode		~~Motorola~~	1N4003	845-400-3X
R101	47 ohm	Resistor	2W	Speer	RC42GF470J	804-470-05
R102,R123, R107,R108,R114	1K 4.7K		½W, 5%	Speer	RC20GF472J	802-472-05
R140, R110	10.2K		1/8W, 1%	Dale	RN60C1022F	813-102-2F
R111,R119	0-10K	Potentiometer		Bourns	3095Y-103	819-103-30

UPS 502-1 & UPS 103-1 INVERTER LOGIC BD ASSY. (Continued)

SCHEMATIC DESIGNATION	VALUE	DESCRIPTION OR TYPE	RATING	MANUFACTURER		ELGAR PART NUMBER
				NAME	PART NUMBER	
R112	16.5K		1/8 W, 1%	Dale	RN60C1652F	813-165-2F
R113,R124,R135	10K		½W, 5%	Speer	RC20GF103J	802-103-05
R136,R137,R139						
R115,R116,R117	15K		½W, 5%	Speer	RC20GF153J	802-153-05
R118	100K		1/8W, 1%	Dale	RN60C1003F	813-100-3F
R120	4.75K		1/8W, 1%	Dale	RN60C4751F	813-475-1F
R121,R125,R133	22K		½W, 5%	Speer	RC20GF223J	802-233-05
R126,R130	47K		½W, 5%	Speer	RC20GF473J	802-473-05
R127,R128,R129	470 ohm		½W, 5%	Speer	RC20GF471J	802-471-05
R131						
R132	0-1K	Potentiometer		Bourns	3059Y-102	819-102-30
R134	1.21K		1/8W, 1%	Dale	RN60CGF1211F	813-121-1F
R138	2.2K		½W, 5%	Speer	RC20GF222J	802-222-05
R141,R142,R143	20K		½W, 5%	Speer	RC20GF203J	802-203-05
R144						
Q101		Transistor		RCA	40250V1	839-402-5V
Q102,Q103,Q104		Transistor		Fairchild	2N5682	837-568-2X
Q105						
Q106		Transistor		Fairchild	2N3638	834-363-8X
Q107		Transistor		Fairchild	2N3567	835-356-7X
Z101,Z103		I.C.		Motorola	MC672P	849-672-PX
Z102,Z104		I.C.		Motorola	MC664P	849-664-PX
Z105,Z106,Z107		Oper. Ampl		Motorola	1741CG	849-174-1X
Z108,Z111,Z114						
Z115						
Z109,Z110,Z112,		I.C.		Motorola	MC668P	849-668-PX
Z116,Z117						
Z115		I.C.		Motorola	MC675P	849-675-PX

UPS 502-1 & UPS 103-1 CHARGER LOGIC BOARD ASSY. 628-104-40

SCHEMATIC DESIGNATION	VALUE	DESCRIPTION OR TYPE	RATING	MANUFACTURER		ELGAR PART NUMBER
				NAME	PART NUMBER	
C101	.47 uf		200V, 5%	IMB	ZA2C474J	823-475-61
C102	100 uf		25V	Sprague	500D107G025DD7	824-107-51
C103,C107	33 uf		25V	Sprague	196D336X0025LA3	823-336-51
C104,C105	.01 uf	Disc		Centralab	DDM103	821-103-00
C106	.1 uf		200V, 10%		192P10492	822-104-05
C108	2 uf		200V 1%	IMB	ZA2C205F	822-205-13
C109	1 uf		35V	Sprague	196D105X035JA1	823-105-61
C110	.33 uf		200V, 5%	IMB	ZA2C334J	822-334-53
CR101		Zener Diode			1N5245	843-524-5X
CR102-CR112, CR118-CR121		Diode			1N914	844-914-XX
CR113		Zener Diode			1N821	843-821-XX
CR114-CR117		Diode			1N4003	845-400-3X
K1					E1A12	
R101	47		2W, 5%	Speer	RC42GF470J	804-470-05
R102,R136,R138	2.2K	Carbon	½W, 5%	Speer	RC20GF222J	802-222-05
R103,R120,R129, R142	10K	Carbon	½W, 5%	Speer	RC20GF103J	802-103-05
R104,R126	1.5K	Carbon	½W, 5%	Speer	RC20GF152J	802-152-05
R105	100K	Carbon	½W, 5%	Speer	RC20GF104J	802-104-05
R106,R109,R117, R118,R121,R134, R139	15K	Carbon	½W, 5%	Speer	RC20GF153J	802-153-05
R107,R114,R135 R140	1K	Carbon	½W, 5%	Speer	RC20GF102J	802-102-05
R108,R137	470	Carbon	½W, 5%	Speer	RC20GF471J	802-471-05
R110,R119	220	Carbon	½W, 5%	Speer	RC20GF221J	802-221-05
R113,R122	4.7K	Carbon	½W, 5%	Speer	RC20GF472J	802-472-05
R112,R116,R141 R111	47K	Carbon	½W, 5%	Speer	RC20GF473J	802-473-05
R115	180	Carbon	½W, 5%	Speer	RC20GF181J	802-181-05
R123,R131	150K	Carbon	½W, 1%	Speer	RN65D1503F	816-150-3F
R124	0-5K	Potentiometer		Bourns	3059Y5K	819-502-30
R125	2.21K	Metal Film	1/8W, 1%	Dale	RN60C2211F	813-221-1F

UPS 502-1 & UPS 103-1 CHARGER LOGIC BOARD ASSY. (Continued)

SCHEMATIC DESIGNATION	VALUE	DESCRIPTION OR TYPE	RATING	MANUFACTURER		ELGAR PART NUMBER
				NAME	PART NUMBER	
R127,R132	0-10K	Potentiometer		Bourns	3059Y10K	819-103-30
R128	1.21K	Metal Film	1/8W, 1%	Dale	RN60C1211F	813-121-1F
R130	100	Carbon	½W, 5%	Speer	RC20GF101F	802-101-05
R133	1.62K	Metal Film	1/8W, 1%	Dale	RN60C1621F	813-162-1F
R143	3.3K	Carbon	½W, 5%	Speer	RC20GF332F	802-332-05
Q101				RCA	40250V1	839-402-5V
Q102,Q106,Q107				Fairchild	2N3567	835-356-7X
Q103,Q104				Fairchild	2N5682	837-568-2X
Q105				Fairchild	2N3638	834-363-8X
Z101,Z104		I.C.		Motorola	MC668	849-668-PX
Z102		I.C.		Motorola	MC679	849-679-PX
Z105-Z110		Op Amp		Motorola	1741CG	849-174-1X
Z103		I.C.		Motorola	MC664	849-664-PX

SECTION VIII
OPTIONAL STATIC BYPASS SWITCH

8-1. INTRODUCTION

8-2. This section has been prepared for use with the "optional" Static Bypass Switch SBS05-1 and 10-1. The information it contains concerns the description, theory of operation, maintenance, and information regarding field installation of the SBS's in the event it is not ordered at the same time as the UPS. Also provided is a parts list and schematics to aid in maintaining the SBS at optimum performance.

8-3. GENERAL DESCRIPTION

8-4. The standard UPS units are equipped with a electro-mechanical bypass switch which will make the reverse transfer (to connect the critical load directly to the AC line in event of an UPS malfunction) with a delay of 50 to 150 milliseconds. If this power interruption is unacceptable, the optional high-speed Static Bypass Switch should be added to the ELGARD system. This switch effects the transfer without interruption on a make-before-break basis, assuring that there will be no transient which is recognizable to computer systems or other sophisticated equipment.

8-5. The ELGARD Static Bypass Switch senses the critical load voltage and completes a reverse transfer if either the high or low voltage limits are exceeded. In addition, the switch continuously monitors the internal circuitry of the UPS and can actually anticipate a critical load failure due to an UPS malfunction.

8-6. FIELD INSTALLATION

8-7. In the event the SBS is not ordered at the same time as the UPS it can be "field installed" on site with a minimum effort. The SBS consists of a power pack assembly and a SBS Logic Board. To field install the SBS perform the following procedure:

WARNING

Ensure all power is OFF to the UPS prior to installing the SBS. Failure to comply may result in serious shock.

1. Plug the SBS Logic Board in connector J1 located at the circuit board card cage.
2. Install the SBS power pack assembly on Panel A2.
3. Connect the large wires extending from the power pack to Panel No. 1, TB8. Ref. overall Sch.
4. Connect the SBS power (small wires) to Panel No. 1 as shown on the overall schematic for the UPS.
5. Place the SBS switch, located on Panel No. 1 to the "IN" position.
6. Installation complete.

8-8. THEORY OF OPERATION

8-9. Sensing Circuits

8-10. The SBS has four sensing circuits; two that sense commutating pulses, one that senses if the DC Fuse is blown in the UPS, and one that senses if an over or under voltage condition on the output of the UPS exists. Any one of these circuits will initiate a transfer when a fault is sensed. The commutating pulse sense circuit is identical in both cases; therefore only one is described.

8-11. Commutating Sense Circuit.

8-12. This circuit is made up of Diode Bridge CR101, 102, 103 and 106, Q101, Q104 and their related components. UJT, Q101, operates as an oscillator. The timing, set by C101, R101 and R104, is adjusted to operate at a slightly lower than frequency the incoming commutating pulses. As commutating pulses arrive at the bridge, they are rectified and delivered to the base of Q104 thru R108. Every time a pulse comes in to the sense circuit Q104 is turned on. This causes C101 to discharge through Q104 before it can charge high enough to allow Q101 to fire. Should just one pulse fail to reach the sense circuit Q104 will not turn on. This would allow C101 to charge high enough to fire Q101 which would in turn initiate a transfer. The transfer operation will be discussed later.

DC Fuse Sense Circuit.

The DC fuse sense circuit is wired across the DC fuse. When the fuse opens, it causes a voltage change to appear at the primary of T101. This induces a voltage on secondary of T101, to initiate a transfer.

8-13. Output Voltage Sense Circuit.

8-14. The output voltage sense circuit is made up of the Diode Bridge CR116, 117, 119, 120, Z104, Z105 and related components. AC voltage sensed at the bridge is rectified and filtered by C112 and delivered to the over voltage and under voltage adjustments R131 and R132. The voltage at the arm of the adjustment pots is delivered to Z104 and Z105. Z104 and Z105 are designed to operate in opposite directions. Since both are referenced to a 6.2V zener, CR122, the outputs of Z104 and Z105 are controlled by the voltage coming from R131 and R132.

8-15. When the overvoltage and under voltage points are set, a deadband will appear in between where the output of Z104 and Z105 will be high. If the AC voltage on the output of the UPS increases above the setting of R132, Pin 2 of Z105 will go high causing its output to go low. If the AC voltage drops below the setting of R131, Pin 3 of Z104 will be lower than Pin 2 of Z104 so its output will go low. If the output of Z104 or Z105 goes low it will initate a transfer.

8-16. Transfer Operation.

8-17. When the SBS is installed in the unit, the coil of the control relay K4 is controlled by Q105. When Q105 is OFF the unit is in reverse transfer. The logic circuit made up of Z101, Z102, Q103 and Q105 have been connected to form a latch. This is so once a reverse transfer has been initiated it must be manually reset. There are three types of transfer possible; manual forward transfer to place critical load on the unit, manual reverse transfer to place the critical load on bypass, and an automatic reverse transfer if a failure is sensed by the logic.

8-18. TURN ON AND FORWARD TRANSFER

8-19. When the unit is first turned on the power supplies come up before the commutating pulses start. This allows Q101 to fire which turns on Q102, causing pin 1 of Z101 to pull low forcing pin 3 high and setting the latch. Pin 3 will remain high until a forward transfer is made. When pin 3 is high pin 11 of Z101 is also high turning on Q103. This supplies voltage to start the multivibrator made up of Q108, Q109 and related components. The multivibrator running causes the SCR gates in the SBS Power Pack to turn on. When the forward transfer button on the unit is pushed several things happen. If commutating pulses have started then pin 1 of Z101 is high. When the button is pushed pin 2 of Z103 goes high pulling pin 5 of Z101 low. This causes pin 6 of Z101 to go high which resets pin 3 of Z101 low.

8-20. The signal at pin 3 of Z101 is inverted at Z102 and compared to the level at pin 1 of Z101. If both levels to pin's 4 and 5 of Z102 are high

then pin 6 of Z102 will be low. This level is then inverted to drive the base of Q105 allowing the control relay to close. Since the multivibrator was already running the SCR's in the SBS will carry the load while the output relay is moving. Once in forward transfer we don't want the multivibrator running so when pin 3 of Z101 goes low, pin 11, after a short time delay to allow some overlap caused by R111 and C102, will go low turning off Q103.

8-21. MANUAL REVERSE TRANSFER

8-22. When the reverse transfer button is pushed pin 6 of Z101 is pulled low through CR123. This causes pin 3 of Z101 to go high. This causes two things to happen. Pin 4 of Z102 goes low causing Q105 to turn OFF opening the control relay and at the same time Q103 turns on which starts the multivibrator which in turn fires the SCR's in the SBS so they carry the load until the reverse transfer contactor is seated. At this point the multivibrator continues to run but the contactor will carry all the load current.

8-23. AUTOMATIC REVERSE TRANSFER

8-24. When the unit is up and operating in a forward transfer condition any failure sensed by the sense circuits will immediately cause pin 1 of Z101 to go low. From this point the operation is exactly as in the case of a manual reverse transfer. The electronic transfer is extremely fast so the SCR'S will be ready to take over the critical load as soon as the forward transfer contactor begins to open up, with virtually no transfer time involved at all.

8-25. MAINTENANCE

8-26. The maintenance guide presented in Section V of this instruction manual should be followed when performing any maintenance. However to aid in troubleshooting the SBS circuitry Table 8-1 is provided.

WARNING

Extreme care must be taken when troubleshooting. Ensure personal contact with components is avoided when power is on to eliminate the possibility of hazardous shock.

8-27. PARTS LIST

8-28. A parts list of the SBS05-1 and SBS 10-1 is provided in Table 8-2. It is recommended that when ordering spare parts the guidelines presented in Paragraph 7-3 are followed.

8-29. DIAGRAMS

8-30. Also provided in this section are assembly drawings and schematics pertaining to the Static-Bypass Switch. The diagrams included are:

a. Optional SBS Pwr. Pack Assy.

b. Optional SBS Pwr. Pack Schematic

c. Optional SBS Logic Bd. Assy.

d. Optional SBS Logic Bd. Schematic

TABLE 8-1. TROUBLESHOOTING CHART

Problem	Probable Cause	Remedy
a. UPS will not forward transfer	1. Pin 6 of Z103 not going low when forward transfer button depressed.	1. Check for voltage to pin 20 on SBS Logic Board, with button depressed.
	2. Z103 faulty	2. Replace Z103.
	3. Faulty gate in Z102	3. Replace Z102.
	4. Q105 bad	4. Replace Q105.
	5. Faulty gate in Z101	5. Replace Z101.
	6. UPS output voltage too high or too low	6. Set output to proper voltage. Anode of CR118 should be high.
b. UPS will forward transfer, but immediately reverse transfer by itself.	1. Q102 is being turned on by one of the sensing circuits	1. Short C101 and C103 one at a time to determine which circuit is causing the problems. Be sure free running timing of UJT in problem circuit is correct. 10 ms for 1Ø units, 4 ms for 3Ø units.
	2. UJT timing OK, but Q104 (Q107) not discharging C101 (C103)	2. Replace Q104 (Q107).
	3. Q104 (Q107) is good but not turning on due to bad diode (CR101, 102, 103, 104, 106, 107, 108, 109, 110, 113)	3. Check and replace any bad diode.
c. Unit does not reverse transfer in static mode.	1. Q101 (Q106) not oscillating	1. Replace Q101 (Q106).
	2. Q102 bad	2. Replace Q102
	3. Bad gate in Z101	3. Replace Z101.
	4. Q103 bad	4. Replace Q103.
	5. Multivibrator not running due to Q108 or Q109 being bad.	5. Check and replace if necessary.
d. Unit blows D.C. fuse on forward transfer with SBS installed	1. Multivibrator not turning off when in forward transfer due to bad gate in Z101	1. Replace Z101.
	2. Q103 shorted	2. Replace Q103.
	3. Input power phasing not in phase with output power.	3. Check and correct if necessary.

TABLE 8-1. TROUBLESHOOTING CHART (Continued)

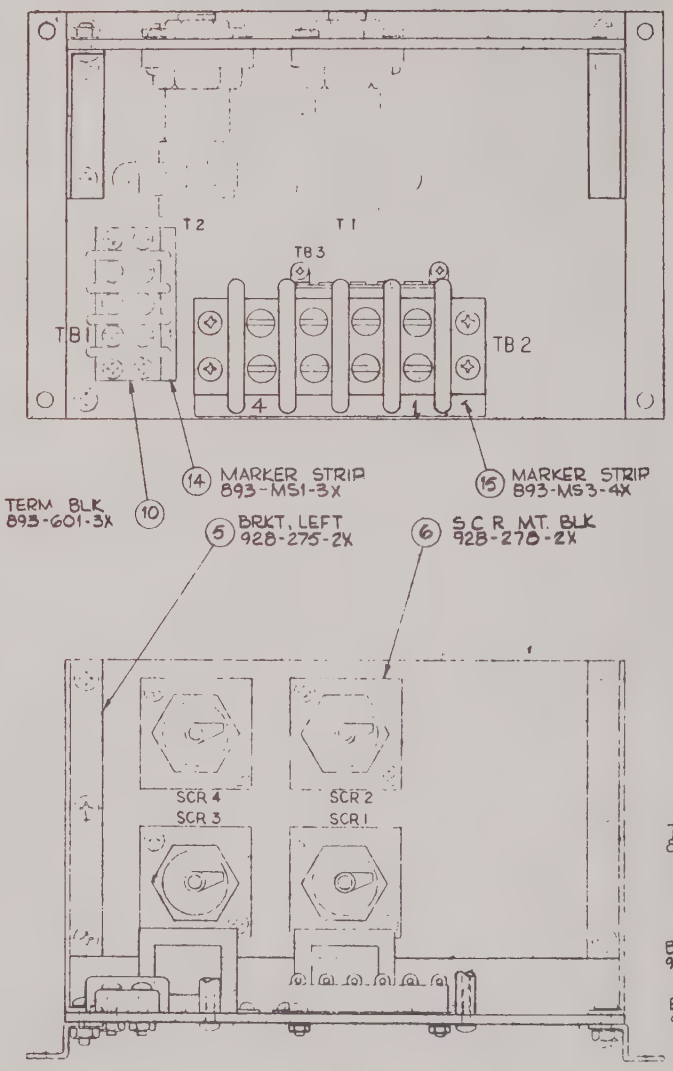
Problem	Probable Cause	Remedy
e. Unit automatically forward transfers when D.C. circuit breaker is closed.	1. Q105 bad. 2. Faulty gate in Z102.	1. Replace Q105. 2. Replace Z102.
f. Unit does not automatically reverse transfer with too high or too low UPS output voltage, but functions properly for all other conditions	1. R131 or R132 not adjusted properly. 2. Z104 or Z105 faulty 3. CR118, 121 open 4. AC voltage not getting to SBS logic board due to broken wire or solder joint.	1. Adjust to desired limits. 2. Replace Z104, Z105. 3. Replace CR118 or CR121. 4. Check voltage at logic board. 120 VAC for 1Ø unit, 12 VAC for 3Ø unit. Repair wiring as necessary.

TABLE 8-2. SBS 05-1 AND SBS 10-1 (Optional)

SCHEMATIC DESIGNATION	VALUE	DESCRIPTION OR TYPE	RATING	MANUFACTURER		ELGAR PART NUMBER
				NAME	PART NUMBER	
SBS POWER PACK (Located on Panel No. 2)						
TB1		Term. Block		Kulka	601-3	893-601-3X
TB2		Term. Strip		Smith	864	893-854-XX
TB3		Term. Block		Cinch Jones	4-150	893-150-04
T1		Xfmr.		Elgar		990-502-90
SCR1-SCR4	"SBS05-1"	SCR		G.E.	C147M	846-C14-7M
SCR1-SCR4	"SBS10-1"	SCR		G.E.	C152M	846-C15-2M
R101	120	Wire Wound	5W, 5%	Dale	CW5 120R	807-121-05
SBS LOGIC BOARD				Elgar		613-122-41
R101,112,131,132	20K	Potentiometer		Bourns	2059Y	819-203-30
R102,111,113	470	Carbon	½W, 5%	Speer	RC20GF471J	802-471-05
R103	15K	Carbon	½W, 5%	Speer	RC20GF153J	802-153-05
R104,114	82K	Carbon	½W, 5%	Speer	RC20GF823J	802-823-05
R105	1.5K	Carbon	½W, 5%	Speer	RC20GF152J	802-152-05
R106,115,124,125	100	Carbon	½W, 5%	Speer	RC20GF101J	802-101-05
R107,117,126 R128,134,135	1K	Carbon	½W, 5%	Speer	RC20GF102J	802-102-05
R108,116,133	4.7K	Carbon	½W, 5%	Speer	RC20GF472J	802-472-05
R109,118	220	Carbon	½W, 5%	Speer	RC20GF221J	802-221-05
R110,119	22	Carbon	½W, 5%	Speer	RC20GF220J	802-220-05
R120,123	10	Wire Wound	10W, 5%	Dale	CW10 10R	808-010-05
R121,122	200	Carbon	1W, 5%	Speer	RC32GF201J	803-201-05
R127	47	Carbon	2W, 5%	Speer	RC42GF470J	804-470-05
R129	2.2K	Carbon	½W, 5%	Speer	RC20GF222J	802-222-05
R130	330K	Carbon	½W, 5%	Speer	RC20GF334J	802-334-05
R136,137	3.3K	Carbon	½W, 5%	Speer	RC20GF333J	802-333-05
CR101,102,103, 106,107,108, 109,113		Diode		Comm	1N4003	845-400-3X
CR104,105,110,111 112,118,121,123		Diode		Comm	1N914	844-914-XX

TABLE 8-2. SBS 05-1 AND SBS 10-1 (Continued)

SCHEMATIC DESIGNATION	VALUE	DESCRIPTION OR TYPE	RATING	MANUFACTURER		ELGAR PART NUMBER
				NAME	PART NUMBER	
CR114		Diode		G.E.	1N5624	845-562-4X
CR115		Zener			1N5245	843-524-5X
CR116,117,119, 120		Diode		Comm	1N4004	845-400-4X
CR122		Zener		Comm	1N821	843-821-XX
C101,103	.1 uf		100V, 1%	IMB	BA1B104F	822-104-11
C102,104,105	1 uf		35V		196D105X035JA1	823-105-61
C106	.47		600V		600VZA2G474J	822-474-58
C108	100 uf		25V		500D107G025DD7	824-107-51
C109	1100 uf		50V		39D 1100-50	826-118-11
C110	2 uf		200V, 5%		ZA2C205J	822-205-53
C111	.01 uf	Disc			DDM103	821-103-00
C113	.001 uf	Disc				821-102-00
C114,115	.0033 uf		200V, 10%		192P33292	822-332-05
Q101,106		Transistor			2N2646	830-264-6X
Q102,103,104,107		Transistor			2N3567	835-356-7X
Q105,108,109		Transistor			2N3767	839-376-7X
Q110		Transistor			40250V1	839-402-5V
Z101		I.C.		Motorola	MC668P	849-668-PX
Z102		I.C.		Motorola	MC672P	849-672-PX
Z103,104,105		Op Amp		Motorola	1741CG	849-174-1X


T2
T1
TB3
TB1
TB2
TERM BLK
893-601-3X
10
14 MARKER STRIP
893-MS1-3X
15 MARKER STRIP
893-MS3-4X
5 BRKT, LEFT
928-275-2X
6 S C R MT. BLK
928-270-2X
SCR 4
SCR 3
SCR 2
SCR 1

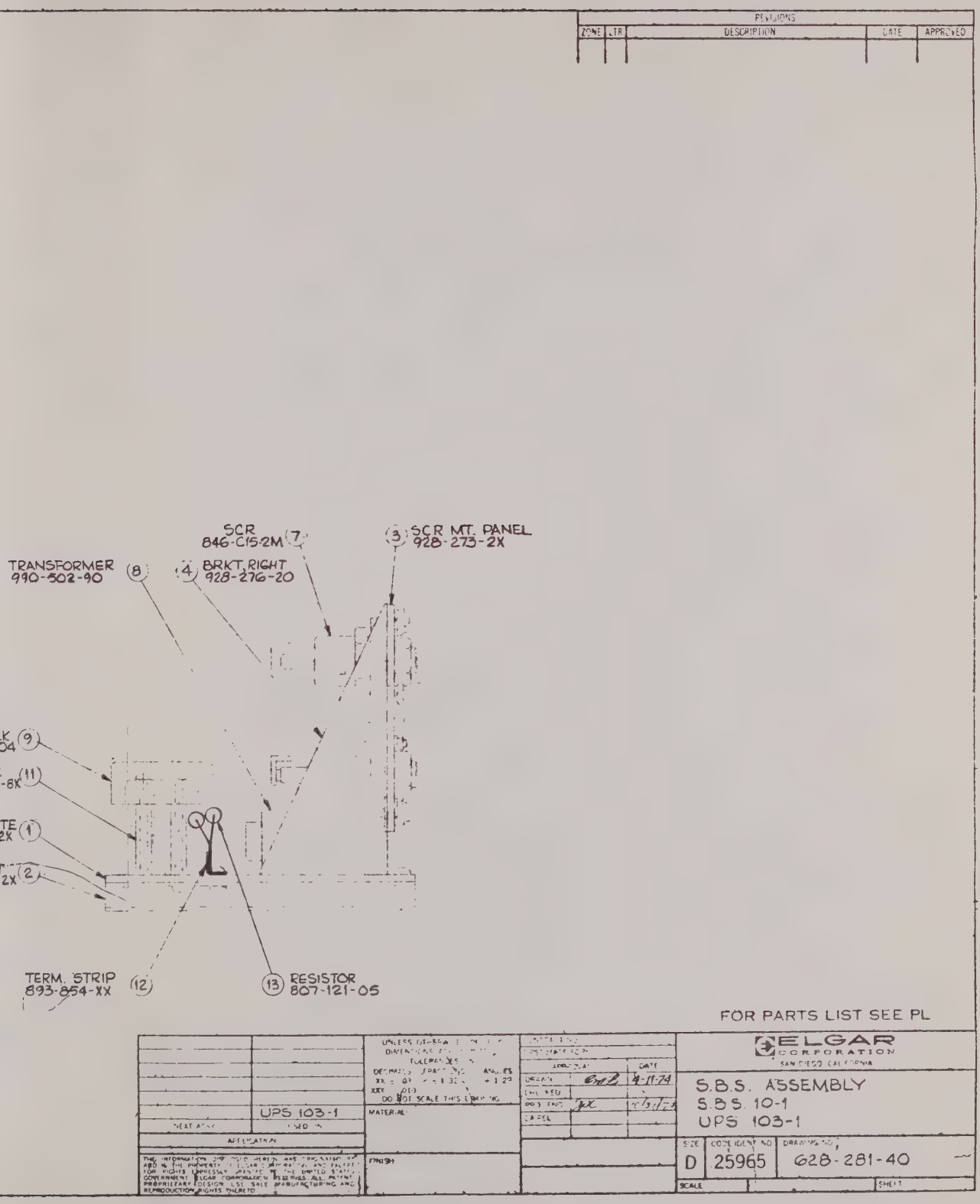
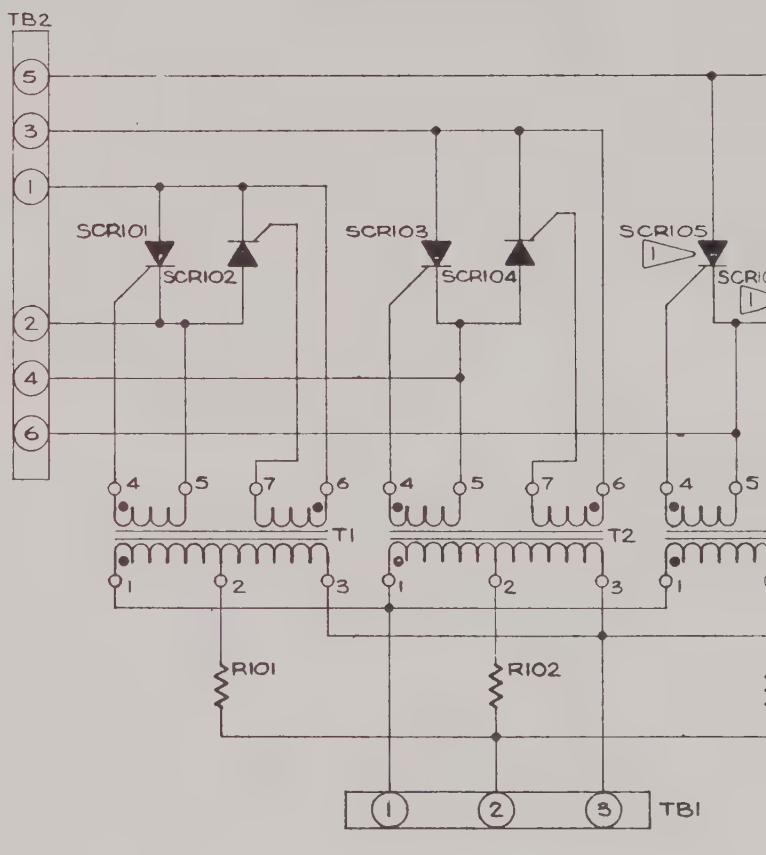


Figure 8-1. Optional SBS Pwr. Pack Assy.



	1
NEXT ASSY.	
APPLICATION	

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GOVERNMENT, ELGAR CORPORATION RESE
PROPRIETARY, DESIGN, USE, SALE, MAN
REPRODUCTION RIGHTS THERETO

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

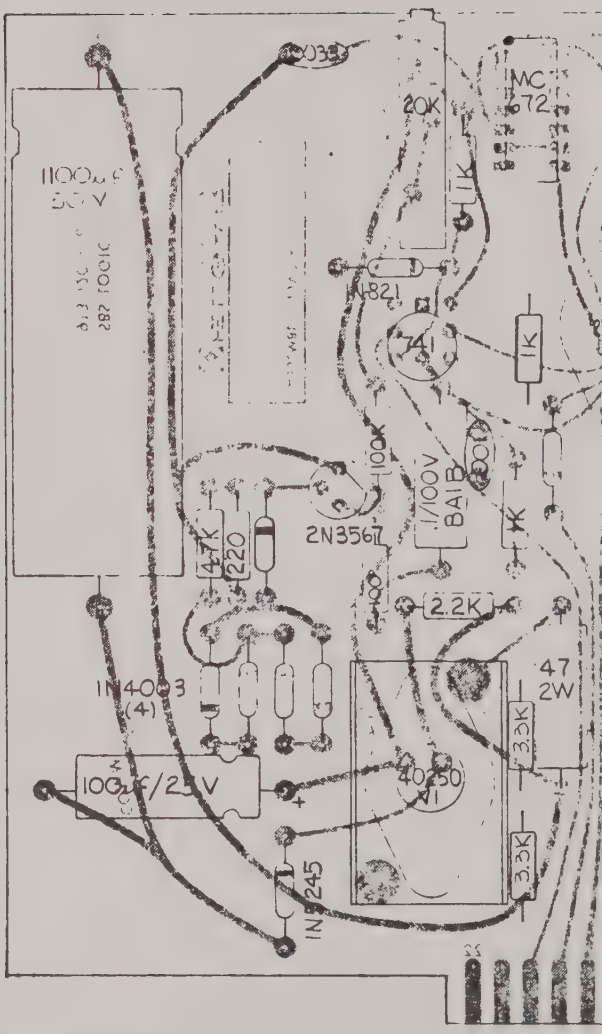
NOTES:

1 NOT USED ON SBS-1

FOR PARTS LIST SEE PL

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS FRACTIONS ANGLES XX ± .03 ± 1/32 ± 1/2° .XXX ± .010 DO NOT SCALE THIS DRAWING	CONTRACT NO.	ELGAR CORPORATION SAN DIEGO, CALIFORNIA	
	FIRST MADE FOR:		
	APPROVAL / DATE		
	DRAWN: ESTUDILLO 4/18/74		
	CHECKED:		
	PROJ ENG: 5/22/74	POWER PACK STATIC BYPASS SWITCH	
	QA-REL:		
MATERIAL:		SIZE: C	CODE IDENT. NO.: 25965
FINISH:		DRAWING NO: 613-121-60	
		SCALE: —	SHEET 1 OF 1

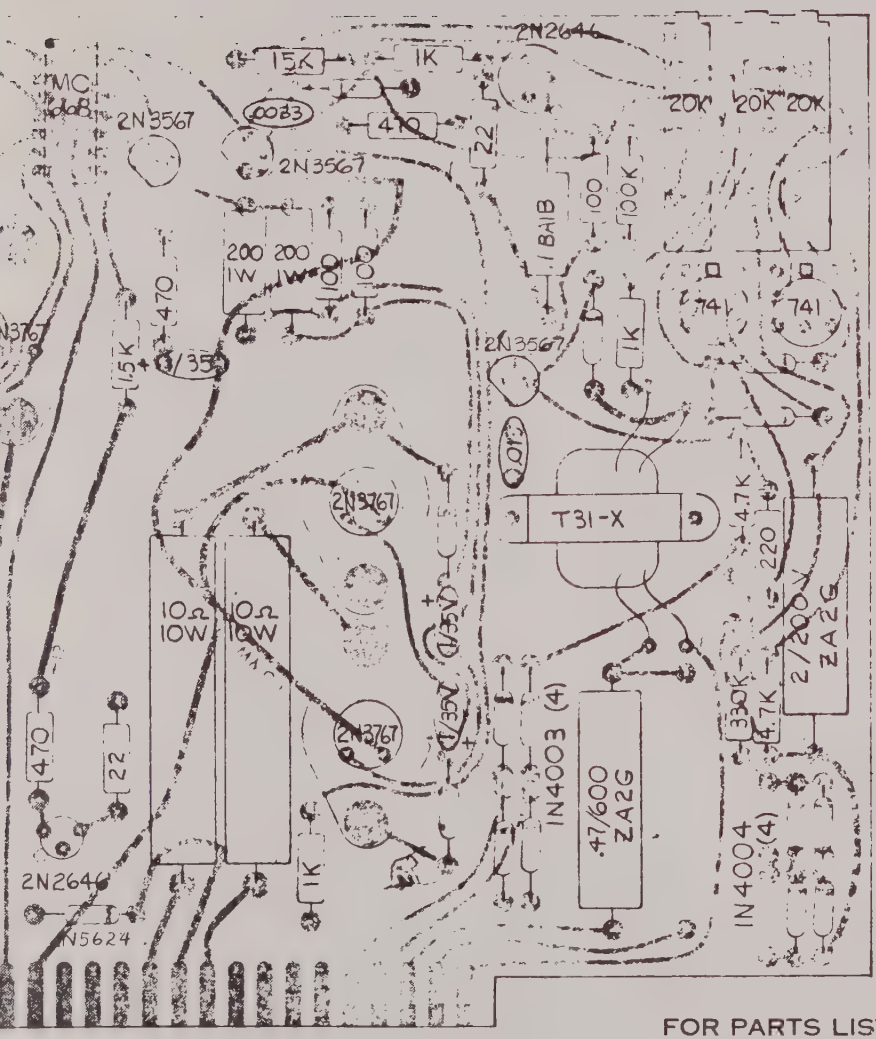
Figure 8-2. Optional SBS Pwr. Pack Schematic



UNLESS OTHERWISE SPECIFIED

1. ALL RESISTOR VALUES IN Ω ½ W.
2. ALL CAPACITOR VALUES IN μF
3. ALL DIODES IN914

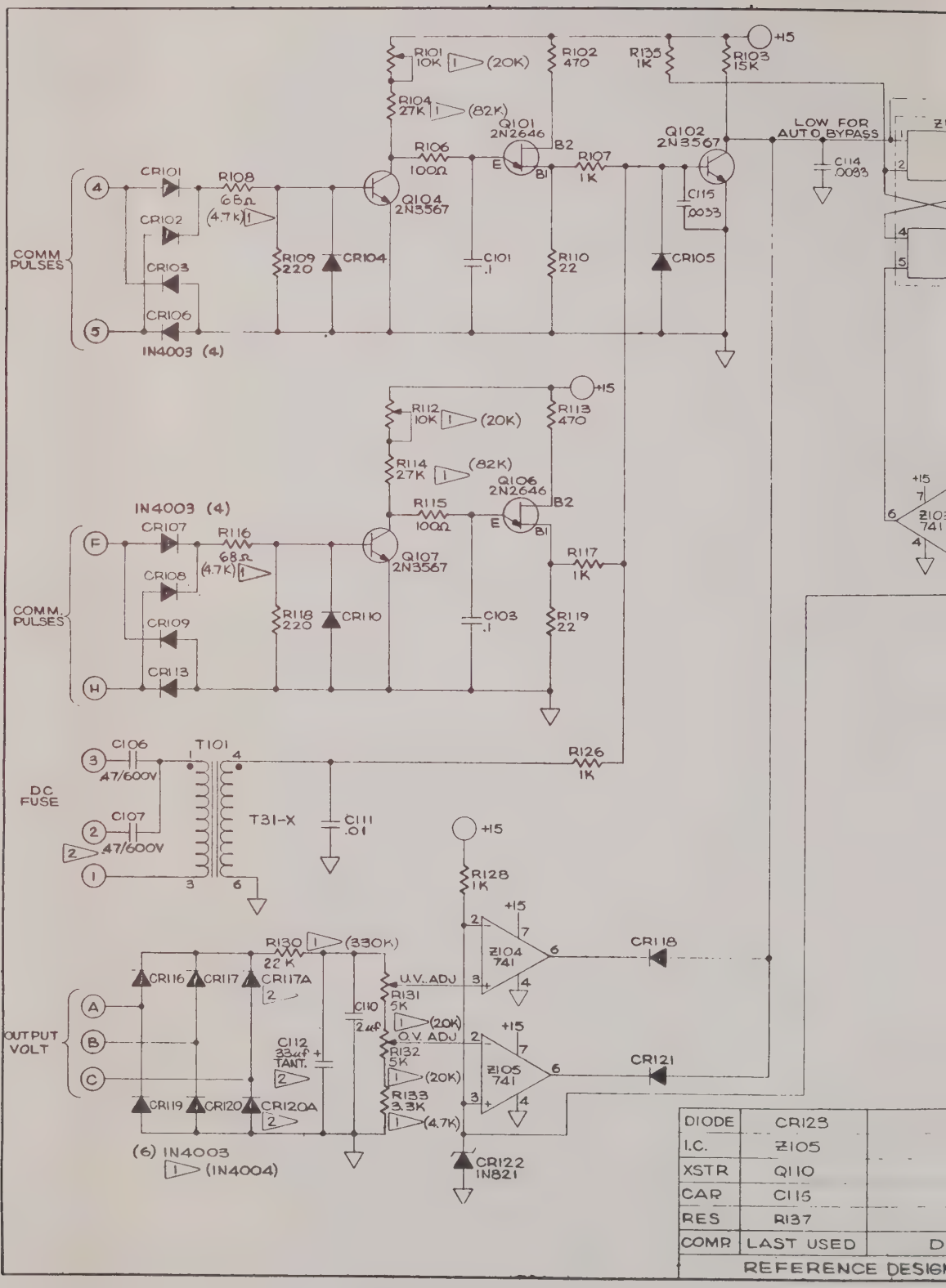
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	41	ECN # 2B1,279	2-26-75	5/6/75



FOR PARTS LIST SEE PL

CONTRACT NO.			ELGAR CORPORATION SAN DIEGO, CALIFORNIA
FIRST MADE FOR:			
APPROVAL		DATE	
DRAWN	D JONES	10/14/74	1Ø SBS LOGIC
CHECKED			
PROJ ENG	JWC	10/14/74	
QA-REL			
			SIZE: — CODE IDENT NO: 25965 — DRAWING NO: 613-122-41
			SCALE: — SHEET:

Figure 8-3. Optional SBS Logic Bd. Assy.



DIODE	CR123	
I.C.	Z105	
XSTR	Q110	
CAP	C115	
RES	R137	
COMP	LAST USED	D

REFERENCE DESIGN

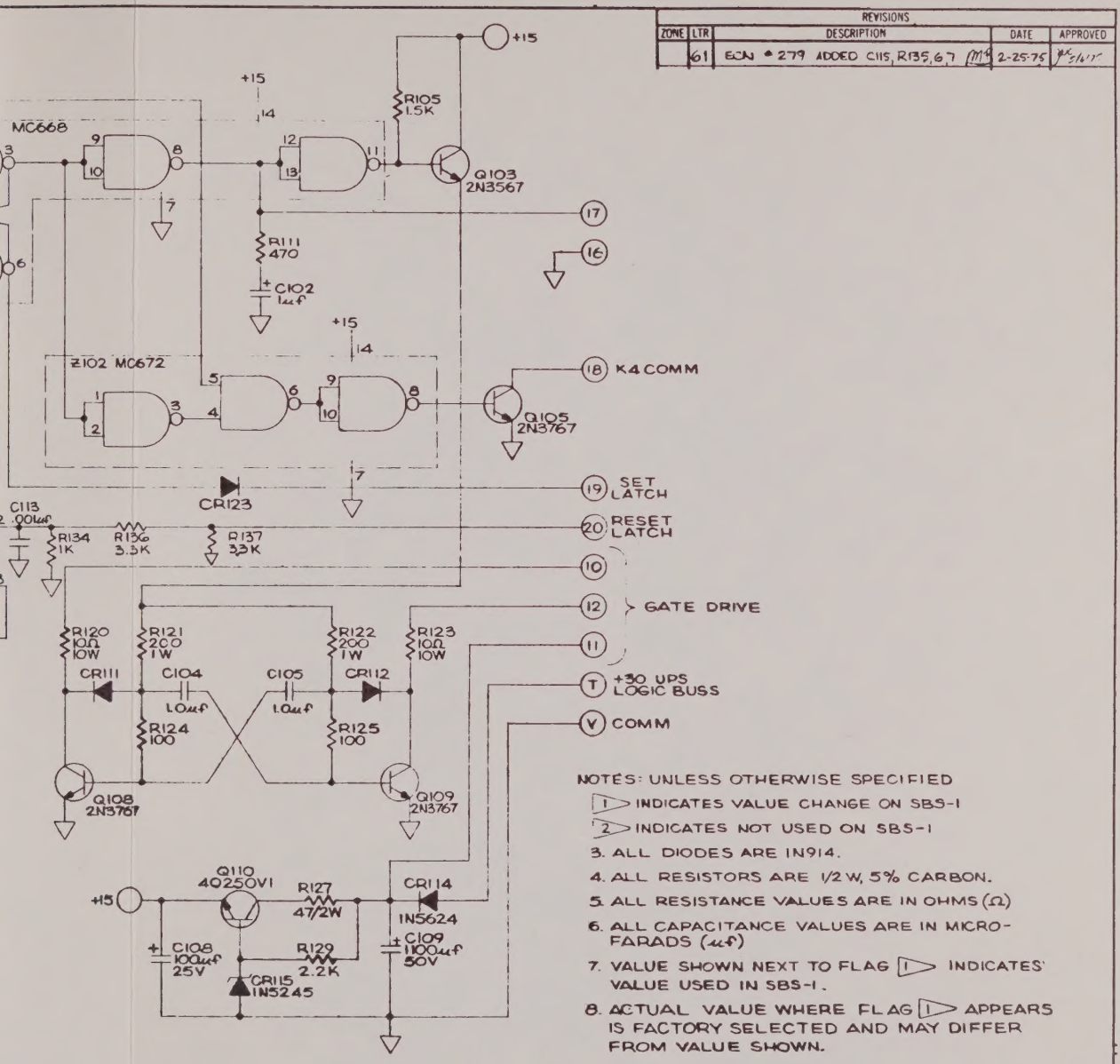


Figure 8-4. Optional SBS Logic Bd. Schematic

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MA29288